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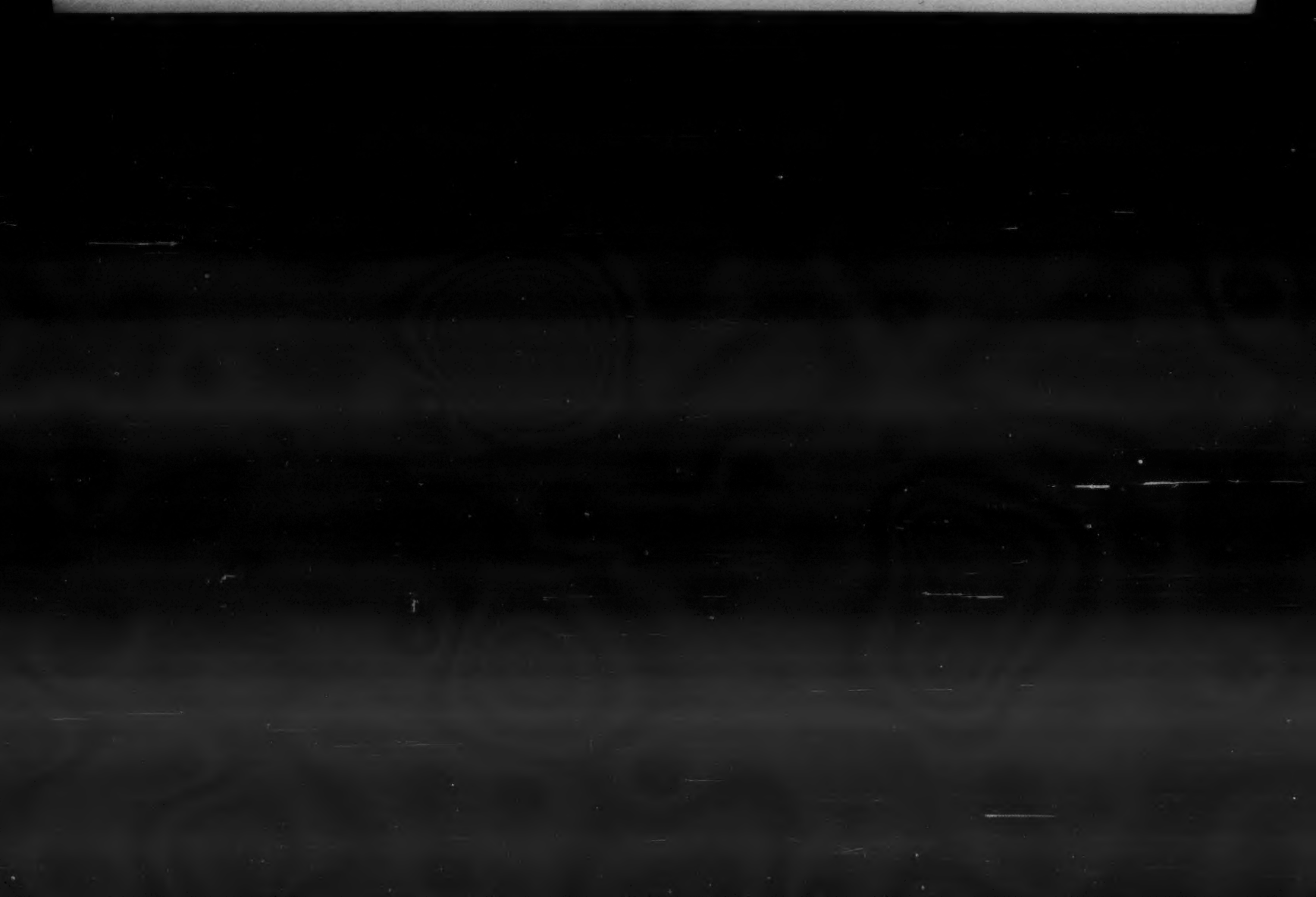

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PREVENTION OF DISABILITY AFTER TRAUMATIC DISLOCATION OF THE HIP

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TRAUMATIC dislocation of the hip is fortunately uncommon because it usually is followed by some degree of permanent disability in the hip joint. In civilian life practically all traumatic dislocations follow automobile collisions, falls, or crushing injuries. In military experience, on the other hand, jeep accidents have been the source of many of these injuries for, as Urist states, "the jeep seems to possess special structural characteristics which put the soldier in a favorable anatomic position for the production of this special injury." Since the earliest times, surgical textbooks have devoted much space to descriptions of the anatomic details and reduction methods of dislocations of the hip. However, it has only been in the last few decades that the important circulatory problems related to this injury have been understood. As a consequence, the recommendations for postoperative care have been faulty and this has resulted in late disability of the hip which was not always observed by the surgeon who originally treated the case. In this study of 44 cases we were impressed with the high percentage of late disability after this injury, and the less serious disability in those cases that received adequate protection or that required prolonged bed rest for treatment of other associated fractures.

In the 44 cases which we have observed, 37 were males and 7 females. The ages ranged from 4 to 64 years with the average age 30½. Automobile and jeep collisions accounted for 36 cases, while falls from a height or aeroplane crashes accounted for 8 cases.

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Twenty-two of the cases were recent and had been treated by us at the time of the injury or immediately afterward, and 22 old cases were seen because of persistent symptoms.

All of the 22 old cases had various degrees of deformity of the femoral head with pain and disability. Of course, it was only the group who suffered pain in the hip that sought medical advice. In those cases in which the record revealed the period of protected weight bearing, it was found that 3 cases used crutches for three months, 2 patients used crutches for two months, 2 for one month and 2 for three weeks. Six of these patients had had open reductions of the dislocation at the time of the accident. In other words, none of these patients had had prolonged protection of the hip while the circulation became re-established.

In the 22 recent cases we routinely recommended the use of crutches for 6 to 12 months. Six of these patients were confined to bed with other long bone fractures and during this enforced rest their hips produced no symptoms and roentgenograms revealed no changes in the bone. Most of these patients we have observed in the past 2 years and we feel that it is too early to give a final opinion on their disability. However, so far, we know of only one patient who developed marked destructive changes in the femoral head.

Traumatic dislocations of the hip are classified anatomically according to the position the head of the femur assumes after the dislocation, although this has little bearing on the ease of reduction or the final functional result obtained. By far the greater number are posterior dislocations, while anterior, obturator, and central dislocations account for the remainder. In this series of 44 dislocations, 36 were posterior, 2 were anterior, 2 were obturator, and 2 were central in type. There were accompanying fractures of the rim of the acetabulum in 13 cases, fracture of the head of the femur in 3 cases, and the sciatic nerve was injured in 3 cases (fig. 1).

The usual mechanism of traumatic dislocation is the exertion of a strong force against the knee while the hip and knee are flexed and the hip adducted. Hence, the common name "Dashboard Dislocations." The acetabulum is deep, the head of the femur fits snugly into it, and the ligaments about the hip are tight when the hip is extended. On the other hand, when the hip joint is flexed and adducted, the surrounding ligaments are lax and the head can then be driven with comparative ease over the shallow posterior rim of the acetabulum.

Uncomplicated posterior dislocations of the hip cause the involved extremity to be held in internal rotation and adduction while there is obvious shortening and undue prominence of the

trochanter. In anterior or obturator dislocations, the extremity is held in external rotation and abduction and the shortening is not so apparent.

Fig. 1a Fig. 1b

Fig. 1a (S.H.M., M., 35). Dislocation of the hip with comminuted fracture of the posterior margin of the acetabulum.

Fig. 1b. Roentgenogram after closed reduction of the hip showing excellent replacement of acetabular fragments.

Roentgenograms reveal the head of the femur displaced out of the hip socket, and if present, fractures of the head or acetabulum, although in some cases stereoscopic films are needed to determine the exact relation of the head to the acetabulum. Bedside portable roentgenograms cannot be depended upon for diagnosis when there is any question of the position of the head. In any case, the history of the accident, the position of the extremity, and the roentgenologic findings will usually confirm the diagnosis.

In an accident severe enough to dislocate the hip, it is apparent there might be associated injuries such as fractures of the patella, femur, tibia, pelvis or skull (fig. 2). With such multiple injuries, the dislocation of the hip is sometimes not recognized while attention is directed to the other serious problems. Nevertheless, dislocation should be borne in mind if there is pain in the hip or evidence of deformity of the extremity. Of these 44 cases, 12, or 27 per cent, suffered associated fractures in other parts of the body.

The extent of damage to the soft tissues about the hip cannot be accurately determined from the roentgenogram or the physical ex-

Fig. 2a

Fig. 2b

Fig. 2a (D.S., 17). Posterior dislocation of the hip with fracture of the pelvis through the acetabulum. After closed reduction of the dislocation, skeletal traction was applied to the leg for 6 weeks.

Fig. 2b. Roentgenogram 3 months later showing healing of the fracture of the pelvis in excellent position with restoration of the normal joint line.

amination. At the moment of the accident, the head of the femur is probably displaced much farther than appears in the first roentgenogram taken at the hospital (fig. 3). This is not difficult to understand when we realize that the position of the hip is changed when the patient is lifted on a stretcher, carried to a hospital in an ambulance, and again lifted into bed. It is, in turn, the interruption of the blood supply at the time of the accident that produces

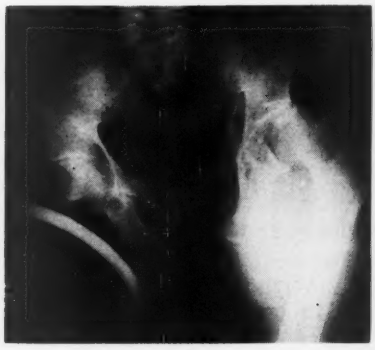

Fig. 3a

Fig. 3b

Fig. 3a (C.P., M., 46). Patient injured in head-on collision and received a posterior dislocation of the hip and fracture of the tibia. Antero-posterior roentgenogram reveals no evidence of the marked posterior displacement which was actually present.

Fig. 3b. Roentgenogram after closed reduction and restoration of the normal joint relationships.

the frequent late disability after traumatic dislocation of the hip.

Reduction methods in pre-anesthetic days employed very strong mechanical traction to overcome the pull of the thigh muscles. Hippocrates recommended the use of an extension windlass, Ambroise Paré advised pulleys and ropes, and others proposed devices such as the Jarvis adjuster, the Coxeter windlass, and the Bloxham dislocation tourniquet. Sir Astley Cooper in 1828 described a method of applying traction with a block and tackle attached to the leg and with a perineal ring for counter-traction. Of these early methods of treatment Percival Pott correctly observed that, "Many or most are much more calculated to pull a man's joints asunder than to set them to right."

Fig. 4a

Fig. 4b

Fig. 4a (C.L.F., M., 28). In an automobile accident the patient received a fractured jaw and femur, and dislocated hip. Traction was applied to the proximal fragment of the femur until the patient was recovered from the shock and facial injuries.

Fig. 4b. Roentgenogram taken after open reduction of the hip and plating of the fractured femur 9 days after the accident.

More gentle means of treatment were followed after Nathan Smith of Baltimore demonstrated in 1831 that the hip could be reduced with the hands without the aid of mechanical appliances. In 1851 William W. Reid of Rochester, New York, showed that reduction could be simplified if the hip was manipulated into flexion, abduction, and external rotation. In 1861 Henry J. Bigelow, professor of surgery at Harvard, revealed by dissections of the cadaver that the muscles did not interfere with reduction of the hip. He showed that the ilio-femoral or inverted-Y ligament could be util-

ized as a fulcrum if the hip was flexed. In 1900 Allis demonstrated in the cadaver that a circumduction maneuver with flexion of the hip and knee would replace most hips. At about the same time, Lewis Stimson developed a method of reduction of dislocation of the hip by placing the patient prone upon a table with the involved thigh hanging over the side. The injured thigh was allowed to hang vertically and the leg was held horizontally while the surgeon pressed downward on the calf of the leg and rotated the thigh from side to side. This method was used successfully without anesthesia in 80 per cent of Stimson's cases.

Fig. 5a

Fig. 5b

Fig. 5a. In jeep collision in Japan, J. L., male, 24, received dislocation of the hip, fracture of the head of the femur, and sciatic nerve compression. Dislocation was reduced 25 days after the accident by the use of curare relaxation and Stimson maneuver.

Fig. 5b. Roentgenogram 4 months later shows fragment of the head of the femur uniting in normal relationship to the head.

At the present time, with spinal, inhalation, and intravenous anesthetics available and relaxing drugs, such as curare, the amount of force required to reduce dislocations of the hip is not great. In fact, it has been found that gentle manipulations under deep anesthesia are much less shocking to the patient and much less likely to increase the damage to the soft tissues about the hip joint than strong manipulations under inadequate anesthesia. Most reduction methods now in use are variations of the Allis or Stimson maneuvers and they generally succeed in uncomplicated recent cases. In cases where there is considerable shock associated with the accident, or accompanying fractures of the same extremity, or if for any reason the

Fig. 6a

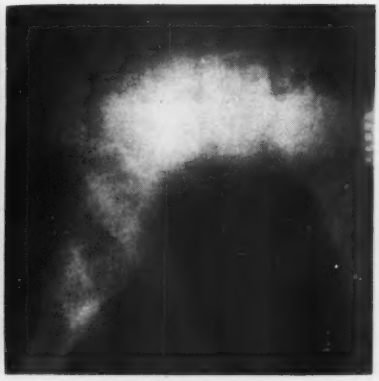

Fig. 6b

Fig. 6a (P.W.C., M., 42). In automobile collision, the patient received a posterior dislocation of the hip and fracture of the head of the femur. Because it was feared that the head fragment might interfere with reduction, it was removed before the hip was levered into the acetabulum.

Fig. 6b. Post-reduction roentgenogram shows hip held in abduction in body cast. Cast was worn 3 weeks. Crutches 2 months.

Fig. 6c

Fig. 6c. Roentgenogram 8 years later shows marked sclerosis of the head of the femur, bony overgrowth about the base of the head and thinning of the joint space. The patient had persistent painful limp.

replacement of the head of the femur must be delayed, the hip can be protected by applying overhead skeletal traction to the femur with the hip and knee flexed 90 degrees. Sometimes the overhead

traction alone will reduce the dislocation. If there is a fracture of the rim of the acetabulum, the fracture fragment will usually fall into proper position after the Allis or Stimson method of reduction. But, since redislocation is a likely possibility when the acetabulum is fractured, traction must be maintained on the involved leg or a cast must be applied with the leg in abduction until the fracture has healed. Open reduction and replacement of the acetabular fragment is seldom necessary. When there is a fracture of the head of the femur, closed manipulations should be tried at first because, even in these cases, the head will usually return to its normal position in the acetabulum. Open reduction is necessary only when the fragment of the head prevents replacement of the hip. When the dislocation has not been recognized or the reduction has been delayed for other reasons, preliminary traction to the leg before manipulation is advisable (fig. 4). Also, the use of curare during manipulation will prevent much of the muscle spasm in old cases. Nevertheless, if the reduction has been delayed more than three or four weeks, there is certain to be permanent damage to the hip. Therefore, the patients should be warned ahead of time of the likelihood of residual disability (figs. 5 and 6).

In the standard textbooks and articles, after the method of reduction of the dislocation was described, very little was mentioned about the postoperative care of these patients. Desault in 1811 said that "practitioners who have seen it . . . have all given an unfavorable prognosis respecting it for the following reasons: first, on account of the inevitable rupture of the round ligament; secondly, on account of the distention, and even laceration of the capsule, and of the compression and overstretching of the nerves and blood vessels. . . ." Although Desault was apparently aware of it, there was no general understanding of the relation of the damaged circulation to the head of the femur and the resultant disability until ten or twenty years ago. Most of the advice on postoperative care has been ineffective until very recently. It was usually stated that the knees should be tied together for a few days to prevent abduction of the hip or that the patient should be kept in bed two or three weeks until the ligaments and soft tissues had healed. There was seldom any mention of the need for protection of the hip against weight bearing until it could be determined if the head were viable or not. Some of the recommended periods of protection were as follows:

Robert Liston (1837), "13 or 14 days."
S. H. Hamilton (1860), "11 days."
H. J. Bigelow (1869), "4 weeks."
L. A. Stimson (1900), "2 or 3 weeks."

Emmet Rixford (1908), "2 weeks."
J. G. Mumford (1910), "2 weeks."
F. J. Cotton (1910), "2 or 3 weeks."
M. E. Preston (1915), "2 to 4 weeks."
Robert Jones (1917), "a week"
Da Costa (1925), "4 weeks."
Wilson and Cochrane (1925), "2 or 3 weeks."
H. D. Sonnenschein (1929), "2 or 3 weeks."
A. R. Jones (1931), "3 to 5 weeks."
L. Bohler (1935), "1 or 2 weeks."
F. H. Albee (1937), "3 or 4 weeks."
H. W. Spiers (1937), "2 or 3 weeks."
P. B. Magnuson (1939), "3 weeks."
H. C. DeBrun (1939), "7 days."
Barbara Stimson (1939), "6 months."
E. O. Geckeler (1940), "4 weeks."
S. W. Banks (1941), "4 to 6 months."
G. A. Caldwell (1943), "8 weeks."
E. L. Compere and S. W. Banks (1943), "2 or 3 months."
A. R. Shands (1944), "8 to 16 weeks."
J. A. Key and H. E. Conwell (1946), "3 weeks."
J. G. Bonnin (1946), "3 to 5 weeks."
M. R. Urist (1947), "6 months."

Examination of these recommendations reveals that only in the last decade has it become recognized that early weight bearing is unsafe. This development is directly related to a clearer understanding of the circulatory damage which occurs at the time of the accident. Now it is known that patients must be prevented from bearing weight on the damaged hip for six to twelve months and the condition of the head of the femur must be regularly checked by roentgenograms if late changes in the joint are to be forestalled.

Interest in the circulatory effects of dislocation of the hip is quite recent though the relation of fracture of the neck of the femur to the circulation in the head has received much more attention because of the greater frequency of that problem. (Axhausen, Santos, Wolcott, Kistler, Chandler, Kolodny, Chandler and Kreuscher, Phemister, Elmslie, Sundt, Rehbein, et al.) Still the vascular changes in the head of the femur are similar and the development of knowledge in each condition has helped in the understanding of the other.

In 1924 Choyce stated that late damage to the hip joint after traumatic dislocation was very rare since he could find only 53 previously reported cases. Ernst Bergmann in 1931 reported a few cases of "non-infectious wedge foci" which occurred in the head of the femur. In a case of old traumatic dislocation of the hip he found

this wedge at the site of the maximum weight bearing.* In 1931 Nicolaysen made a similar observation. Phemister in 1934 remarked that in traumatic dislocation of the hip, the ligamentum teres with its blood vessels is always torn. This is followed by destruction of the circulation to the head which the body tries to repair by creeping substitution of the dead bone with living bone. If weight bearing is allowed during this period the head of the femur is bound to become deformed.

Goldenberg in 1938 described a deformity of the head of the femur three years after a dislocation of the hip which occurred in a 10 year old boy. In 1939 Kleinberg pointed out that dislocation of the hip damaged the blood supply to the bone and that long postoperative protection was necessary. He was among the first to advise drilling of the neck of the femur to try to increase the blood supply in late cases. Potts and Obletz in 1939 studied 5 cases of dislocation of the hip with marked changes in the head of the femur. They were of the opinion that the arthritic manifestations were secondary to damage to the blood supply from dislocation but they felt that long rest to prevent this complication could not be enforced since it would require non-weight bearing for two or three years. Banks in 1941 reviewed the entire literature of this subject and made an elaborate study of 9 cases of aseptic necrosis of the head of the femur after traumatic dislocation. He emphasized that early diagnosis of the condition followed by adequate protection from weight bearing would offer the most hope of preserving the function of the hip. It was his opinion that whenever possible the extremity should be protected from weight bearing for four to six months after the post-reduction period of immobilization. After that, the further care depended upon the roentgenologic appearance of the head of the femur and whether or not it revealed evidence of aseptic necrosis.

King and Richard in 1941 experimented with dislocation of the hip in dogs and found that severe arthritic changes developed in the joint within a few weeks after the dislocation. Watson-Jones in 1942 said that avascular necrosis develops in about 30 per cent of cases of recent traumatic dislocation of the hip. Kleinberg remarked that aseptic necrosis of the head of the femur followed rupture of the ligamentum teres especially if there was too early weight bearing. Bancroft and Murray in 1945 stated that approximately

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*Dr. Sam Banks, of Chicago, who has made extensive studies on this subject, very kindly reviewed our manuscript and offered numerous helpful suggestions. He stated that Bergmann's published roentgenograms reveal that the entire femoral head was necrotic and was undergoing replacement.

50 per cent of traumatic hip dislocations were followed by later degenerative changes in the hip joint.

In 1947 Fahey reported his very thorough studies of the blood supply to the head of the femur (fig. 7). He found that the nu-

Fig. 7

Fig. 7. Injection specimen of the hip from Fahey, 1947, showing the three sources of blood supply—the arteries of the ligamentum teres, the capsular vessels, and the nutrient arteries.

trient artery to the shaft of the femur sent a branch upward which terminated just distal to the epiphyseal plate in children though in adults the terminal branches anastomosed in the head of the femur with branches of the capsular arteries. The arteries in the ligamentum teres were branches from the medial femoral circumflex artery and from the obturator artery and their branches anastomosed with the arteries from the capsule. The arteries of the capsule of the hip were branches from the medial femoral circumflex arteries which traveled through the posterior two-fifths of the capsule and entered the bone at the base of the head. The blood supply to the head of the femur was thus demonstrated to come from three sources, the capsule of the neck, the ligamentum teres, and the nutrient artery of the shaft. Of these sources, two (the capsule and ligamentum teres) are nearly always torn when the hip is dislocated.

In traumatic dislocations of the hip it must be assumed that the head of the femur has been displaced sufficiently to cause marked soft tissue damage. Even though the first roentgenograms taken at the hospital may reveal the head resting on the rim of the acetab-

ulum, it is very likely that the head was displaced farther at the moment of the accident. In experimental dislocations, Pringle demonstrated that a cuff-like tear of the capsule of the joint and also a tear of the ligamentum teres were ordinarily produced. Consequently, all the blood supply to the head of the femur is endangered except that which comes through the nutrient arteries of the shaft of the bone. For this reason, open reduction of dislocation of the hip should be the last resort of treatment since this tends to jeopardize any remaining circulation which might be intact (fig. 8).

Fig. 8

Fig. 8 (M.P.J., F., 47). Sixteen years previously, in an automobile accident, patient received a posterior dislocation of the hip with fracture of the acetabulum. Open reduction was performed at the time of the accident and acetabular fragments wired together. For the past 3 years had had much pain and stiffness in the hip. Reconstruction of the hip and muscle flap transplant were advised.

The period of time the patient should be kept on crutches depends upon the roentgen appearance of the bone, although all cases should be protected at least 6 months. Every 2 or 3 months, roentgen examinations of the hip should be made to determine if there has been any change in the form or density of the bone or if any thinning of the joint space has taken place. If weight bearing is prevented for 6 to 12 months these phenomena are unlikely to occur. If, however, the patient bears weight on a hip with impaired circulation, there will be signs of roentgen changes in the joint (fig. 9). In addition, there will also be limitation of motion and gradual development of painful limp. Sometimes pain may appear as an early first symptom before roentgen changes are noted. In

any case, the patient should again be placed on crutches until the bone recovers normal structure. However, prevention of damage to the joint is far more important than protection of the hip after it has developed.

Fig. 9a

Fig. 9b

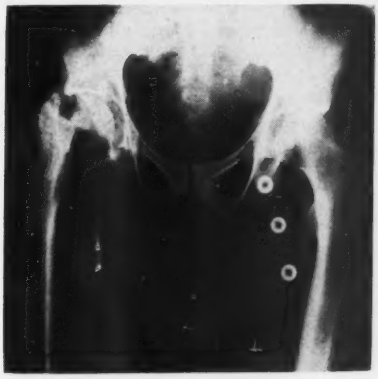

Fig. 9c

Fig. 9a (J.B., M., 44). Patient fell from a ladder and received a posterior dislocation of the hip and fracture of the head of the femur.

Fig. 9b. Roentgenogram after closed reduction of the hip. Patient was on crutches for 3 months.

Fig. 9c. Roentgenogram 10 months later shows aseptic necrosis of the head of the femur with pathologic fracture through the neck due to impaired circulation. Reconstruction of the hip advised.

SUMMARY

Roentgen examination is imperative whenever dislocation of the hip is suspected. The longer the head of the femur remains out of the acetabulum, the greater the soft tissue damage.

Early reduction of the dislocation with complete anesthesia and gentle maneuvers causes less damage to the soft tissues and circulation than great force or wide manipulations.

Open reductions of dislocations of the hip should be the last resort of treatment since they may endanger the already damaged blood supply. Manipulations or manipulations and skeletal traction will effect adequate reduction in practically all cases.

In cases of accompanying fractures of the head of the femur or fractures of the acetabulum, it is advisable to place skeletal traction through the calcaneus or the lower end of the femur for several weeks to prevent redislocation while the fracture is healing. More serious associated injuries, such as fractures of the shaft of the femur or tibia, will necessitate much longer traction but this does not interfere with treatment of the dislocation. In fact, we noticed that patients with associated injuries which required prolonged bed rest suffered less ultimate damage to their dislocated hip than those who were impatient to be up.

In uncomplicated cases, the patients should be kept in bed several weeks until the soft tissues about the hip have had a chance to heal. After that, the patients should be instructed to use crutches for 6 to 12 months, or until the normal roentgen appearance of the bone has been restored.

Follow-up roentgen examination of the hip should be made every 2 or 3 months for at least 12 months to determine if the head is becoming necrotic or not and to facilitate the decision whether more protection is needed.

It is wiser to err on the side of prolonged protected weight bearing than it is to take a chance on early weight bearing and then resort to crutches after degenerative changes in the head of the femur have appeared. In other words, the greatest method of prevention of disability after dislocation of the hip is to protect the head from weight bearing until the blood supply is restored and there is no further danger of developing aseptic necrosis.

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NEW SCRUB-UP TECHNIC FOR SURGEONS

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DURING the past 20 years or more very little improvement has been made in the matter of scrub-up technic of the surgeons' hands preparatory to operations. It is true that certain minor changes in the dip solutions have been made but the basic 10 to 15 minute scrub with soap and water has remained very nearly static.

It is the purpose of this paper to present experiences with a new scrub preparation and a new technic which shortens materially the length of time needed for preparation of the surgeons' hands and which also gives promise of being superior to ordinary soap and scrub brush technic in rendering sterile the surgeons' hands.

About 8 months ago we began using pHisoderm containing 3 per cent hexachlorophene as a scrub preparation for the hands preparatory to operative procedures. This preparation is an antiseptic detergent and was furnished us through the courtesy of the Winthrop-Stearns Company of New York City. Tests were run on the efficacy of the new scrub preparation at St. Josephs Infirmary in Atlanta. For the past 8 months surgeons, house staff and nurses used pHisoderm with 3 per cent hexachlorophene (G-11) in all scrubs preparatory to surgery. Cultures were taken from the hands in 208 instances after they were prepared according to the new technic. The results are shown in the accompanying table.

Technic of no brush scrub-up technic using pHisoderm with chlorophene:

First step: A small quantity (4 to 6 c.c.) of the preparation is squirted into the palm of one hand and then is worked all over both hands and fingers by rubbing the hands together. A small quantity of water is added and the hands, fingers and arms are thoroughly covered and rubbed using the hands only. No brush is used. More water is added and additional amount of the pHisoderm with chlorophene in order to wash the hands and arms thoroughly up to the elbows. This procedure lasts from one to one and one half minutes.

Second step: An orangewood stick is used to clean around and under each nail. The hands and arms are rinsed and step number one is then repeated. After rinsing the hands and arms following this step an aqueous dip such as Zephiran chloride 1:1000 preparation may be used for one minute. Total time for hands is 4 minutes

or less. No brush is used and scrubs for following operations may be one half the above procedure.

No instances of dermatitis have been observed and several surgeons who had mild dermatitis and tender hands from "brush" scrubbing observed their hands to be less tender and the dermatitis healed.

Cultures on plain agar plates and blood agar were made in 208 instances. Surgeons of both the visiting and house staff as well as scrub nurses were included in this study.

TABLE SHOWING RESULTS OF CULTURES TAKEN AFTER THREE MINUTE SCRUBS WITH pHISODERM WITH 3 PER CENT HEXACHLOROPHENE

	Cultures Taken	Negative No Growth	One Colony	Few (1 to 5)	Many
Visiting Surgeons	90	49	15	11	15
Staff Surgeons	34	17	7	7	3
Nurses	84	44	3	15	22
Total	208	110	25	33	40

As may be observed from the table negative hand cultures were obtained after scrubs with pHisoderm containing 3 per cent chlorophene in 110 instances, or 54 per cent of the total number of those tested. A small number of bacterial colonies were found to occur in 58 instances, or 27 per cent. The remaining 19 per cent showed a larger number of colonies to heavy growth. Of particular interest in this study was the fact that of the 208 cultures made 168, or 81 per cent, revealed almost no growth. This figure is reached by adding the negative cultures to the single colony and few (1 to 5) colony cultures. To all practical purposes this group of 81 per cent may be considered negative.

This study revealed no practical difference in the number of negative or positive cultures obtained from the hands of visiting staff surgeons or house staff surgeons and scrub nurses.

The conclusions drawn were (1) that pHisoderm with chlorophene has proved to be a satisfactory agent for sterilizing the surgeons' and nurses' hands before operations. (2) That the usual time consumed in scrubbing is materially shortened by the use of this preparation. (3) That no brush is needed and hence less dermatitis and fewer tender hands were observed as compared to those following the usual soap and brush scrub technic.

Acknowledgment is made to The Winthrop-Stearns Company and Mr. Kenneth Smoot, Regional Manager, for their cooperation in making this material available for this study.

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LONGITUDINAL PIN FIXATION IN COLLES' FRACTURE OF THE WRIST*

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IT seems to be the prevailing opinion that Colles' fracture is a relatively minor injury, one that requires slight knowledge and skill for its proper treatment, and that the results are almost universally good. Careful study of the problem, however, reveals quite the contrary to be true. A Colles' fracture is a very complicated mechanism. Very accurate reconstruction is essential, and results in general are notoriously poor. Particularly is this true in patients past middle age.

Follow-up examinations of many of these cases show radial deviation of the wrist, poor restoration of the angle of inclination of the articular surface of the radius, disturbance of the relationship of the radial styloid, shortening of the radius, and widening of the wrist with improper restoration of the radio-ulnar articulation. There is flattening of the radius, with weak grasp, luxation of the ulna with prominence of the styloid end, periarticular adhesions, stiffness of the fingers, or limitation of rotation of the forearm. It is not infrequent that an elderly patient is seen with permanent stiffness of the fingers and almost complete loss of function from prolonged immobilization.

Since the development of the longitudinal pin, we have been able to accomplish a great deal more in these cases, and in some instances the results have been dramatic.

REPORT OF CASE

Mrs. C. E. W., white female, aged 87, received a fragmented, impacted Colles' fracture of the left wrist on Oct. 9, 1948. There was characteristic silver fork deformity with radial deviation of the wrist, with shortening of the radius and luxation of the styloid end of the ulna. X-ray pictures showed transverse fragmented Colles'-type fracture about three fourths inch above the articular surface of the radius with marked change in the angle of inclination of the articular surface of the radius. She was seen a few minutes after the injury.

Operation: Under pentothal anesthesia a closed reduction was accomplished and the wrist was held in the Cotton-Loder position. The styloid end of the radius could then be accurately palpated. About one fourth inch from the distal end of the radial styloid, on the radial surface a one fourth inch stab wound was made into the skin. A longitudinal pin 6 inches in length and

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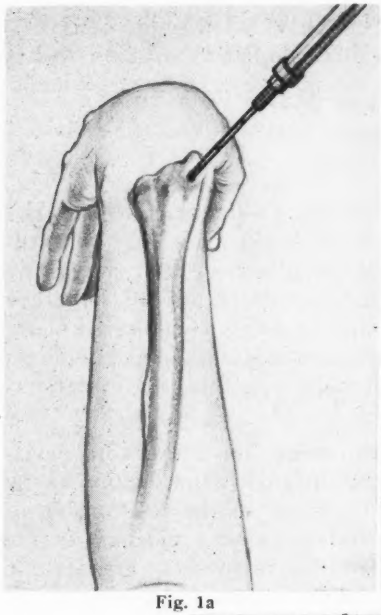

Fig. 1a

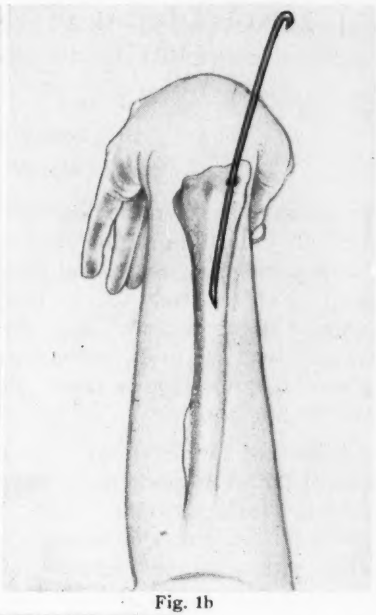

Fig. 1b

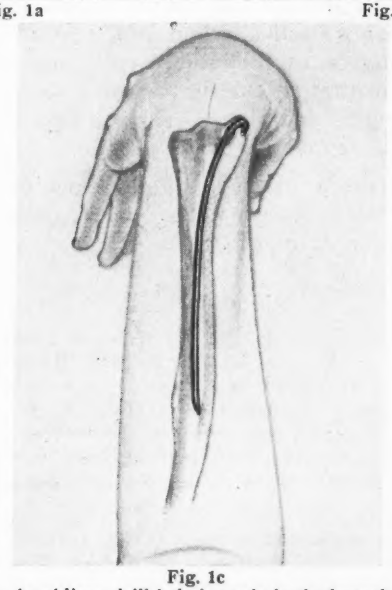

Fig. 1c

Fig. 1 (a) TECHNIC: An oblique drill hole is made in the lateral surface of the styloid of the radius. The fracture has been reduced and held in the Cotton-Loder position. (b) The longitudinal pin has been introduced percutaneously through drill opening. The sled runner point strikes the far cortex guiding the pin down the medullary canal. (c) The pin has been driven home, and the hooked head snugly grasps the cortex of the styloid.

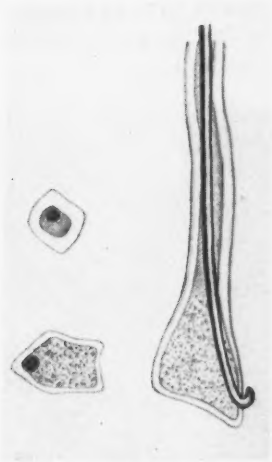

Fig. 2

Fig. 2. Diagrams of longitudinal and transverse sections demonstrating mechanics of the fixation. The contour of the shaft affords three point pressure which makes fixation secure. The distal fragment is held firmly by the hooked head grasping the cortex of the bone, and because of the natural gutter in the lateral wall, which, when the fragment is substantial, prevents anterior or posterior displacement, and prevents radial deviation.

3/32 inch in diameter was chosen for fixation. A drill of suitable size was introduced through this small stab wound and a drill opening was made in the cortex of the bone. When the point of the drill was felt to have penetrated the cortex it was then rocked distally to convert the opening into an oblique one. Through this opening the longitudinal pin was inserted and pushed with the hand through the cancellous bone. When resistance was met it was then tapped gently with a mallet, driving it axially into the medullary canal of the shaft of the radius. When the pin was driven home the skin was sutured with one cotton stitch. It was then found that the radius had been accurately reconstructed, fixation was thoroughly secure, and the formerly luxated ulna remained in its natural position. The operative procedure required less than five minutes. Check-up x-rays showed excellent reconstruction, and as soon as the patient had reacted from her anesthetic it was found that she had no limitation of motion in any direction.

No form of external immobilization was used. Hand and wrist were bandaged with elastoplast to minimize swelling. This was worn until the suture was removed on the eighth day. Function of the entire extremity was permitted and insisted upon immediately.

This procedure has been used in 6 cases. In 5 of them, in which there was a substantial distal fragment, no form of external immobilization was used, because of the rigidity of the fixation. All cases were watched extremely closely for 6 weeks. For the first 4 weeks dorsi-flexion of the wrist and full supination of the forearm was slightly limited due to soreness. There was no loss of function

of the fingers. In one case slight over-correction occurred, with an exaggerated angle of inclination at the wrist and dorsal prominence of the radius.

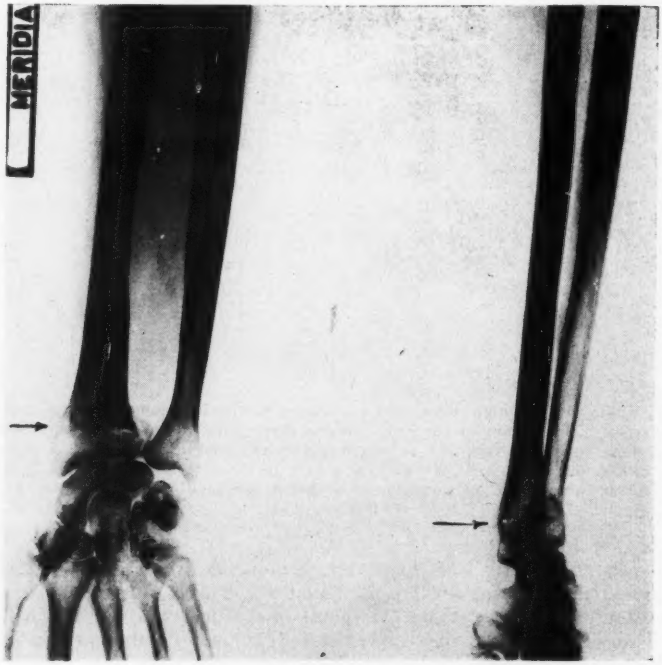

Fig. 3a

In the sixth case there was marked fragmentation of the entire distal end of the radius. The styloid of the radius itself was fragmented, there being one large fragment at the radio-ulnar articulation. Fixation in this case was not secure. The length of the radius was maintained and the relationship of the styloid end of the radius was maintained. There was tendency to recurrence of the silver fork deformity with luxation of the ulna. Molded plaster splints were used in addition in this instance, but the splints were removed at intervals to allow resumption of function.

Discussion

The longitudinal pin used in these cases has been described elsewhere.[3] It is constructed of stainless steel. In cross-sections the pin is round, and its special features are a rounded, hooked head which firmly grasps the cortex of the bone with minimal protrusion

into, and irritation of, the soft tissues. The sled runner point affords its accurate direction into the medullary canal. The sled runner point is so constructed that when the pin is driven into a bone at an ob-

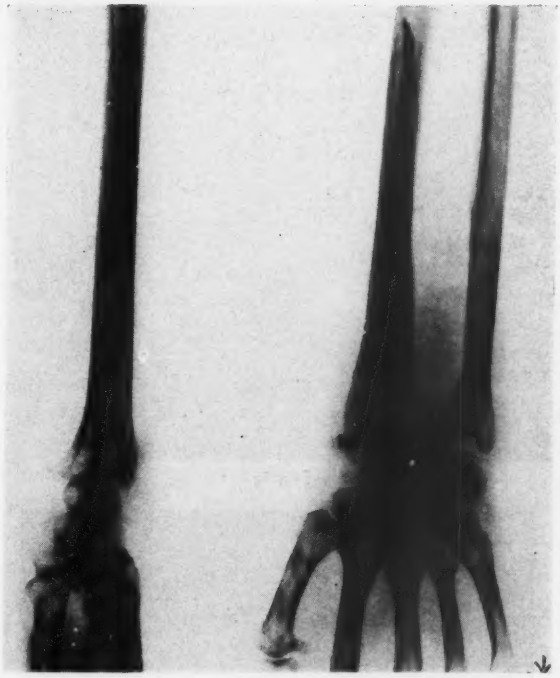

Fig. 3b

Fig. 3 (a). Antero-posterior and lateral x-rays before and (b) five weeks after fixation by longitudinal pin. This patient, an 87 year old woman, wore neither cast nor splint of any kind, and function of hand and wrist was resumed immediately.

lique angle the point strikes the far cortex, gliding down rather than penetrating the cortex, so that the pin accurately finds its way axially into the medullary canal.

The rigidity of the fixation is due to several factors. The rounded, hooked head grasps the cortex at the point of entrance. In the distal fragment, which is cancellous, the pin fits into a natural gutter in the bone in such a fashion that when this portion of the bone is not badly fragmented, the fragment cannot be displaced either to the volar or dorsal side, and due to the mechanics of the fixation radial deviation cannot occur. The natural curvature of the medullary canal of the shaft of the radius is such that three point pressure is secured which makes fixation in the shaft absolute.

Fig. 4a

Fig. 4b

Fig. 4 (a, b). Photographs of the same case at 5 weeks, showing motion. Function was never lost, except for slight limitation of full supination and extreme dorsiflexion because of soreness.

The importance of the triangular ligament must not be minimized. Before it is decided to use no external immobilization it is necessary carefully to test the ulna to see that it will remain in its proper relationship and to see that fixation of the radius is secure. In addition very frequent and close observation is necessary to detect any sign of loosening of the fixation.

Since 1936 we[1,2] have advocated and have been developing the principle of longitudinal pin fixation for fractures of the shaft of long bones. Now that the versatility of the pin has been developed to the point where it can be introduced either through the extremity or side of the bone, it has been possible to adapt it to a large variety of fractures of all the long bones of the body. In none of our experiences has the result been more gratifying than in the treatment of Colles' fracture in elderly patients.

Indications

Due to the wide variety of so-called Colles' fractures it is difficult at this time to draw accurate conclusions as to which specific case is best benefited by pinning. In children the method is probably never indicated because it is not wise unnecessarily to cross an epiphyseal line and because children rarely develop stiffness of the hand and wrist from injury.

Due to the simplicity of the procedure, we feel that it might be indicated in any adult in whom the styloid fragment of the radius is of sufficient size to be grasped satisfactorily by the head of the pin. In crush-type fractures it appears to be of inestimable value to maintain the proper length and relationship of the styloid end of the radius. In these cases it might be necessary to apply plaster splints, at least during a portion of the healing period.

At first glimpse this appears to be a procedure requiring a great deal of skill on the part of the surgeon. Our experience does not lead us to believe that this is true, but it must be borne in mind that a Colles' fracture can be an extremely complicated affair and to be properly treated by any means requires a thorough understanding of its mechanics on the part of the surgeon.

Because of the simplicity of its application and the immediate freedom of function that is permitted the extremity, we believe the method to be indicated in all adults, and most particularly the aged, in whom a satisfactory fixation can be secured.

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PAIN: ITS PHYSIOLOGY AND CONTROL

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THE concept of pain is, of course, as old as the first human. The history of its control constitutes the story of medicine and the first strugglings of the newborn art must have been concerned with the doctor's attempt to control discomfort.

No great strides were made until opium and its derivatives were found. Alcohol was used medicinally; general anesthetics eventually were discovered, and finally coal tar derivatives became known. In late years, the use of synthetic opium derivatives has proved of great value although even yet we have to contend with the side effects, toxicity and habit forming tendencies of these very valuable drugs.

The specialty of neurologic surgery has developed rapidly and direct operative intervention upon the central nervous system has allowed us to make some strides in the treatment of intractable pain. This is of the greatest humane value. Since we have not been able to conquer the dread cancer, we at least have been able to alleviate some of the suffering resultant from its ravages.

The physiologic concept of pain has been worked out although some of the finer aspects are not as yet completely understood. The transmission of painful impulses should be divided into those transmitted by the *central nervous system* and those transmitted by the *autonomic nervous system.*

The former consists of stimulation of the painful nerve endings in the skin or of any other structure with sensory nerve endings, which means any part of the body with the exception of very few tissues.

The painful impulse begins in the sensitive nerve endings and is transmitted along a mixed nerve carrying sensory fibers. The impulses then pass through the posterior root into the posterior horn of the spinal cord and are transmitted by collaterals to the opposite spinothalamic tract.

The spinothalamic tract lies in the anterolateral portion of the spinal cord and ascends the spinal cord with its lowermost fibers inclining medialward as they progress up the cord. The spinothalamic tract passes up to the homolateral thalamus and from there to the postcentral gyrus in the parietal lobe. With the exception of the autonomic pathways, there is no other pathway along which pain travels. The ventral spinothalamic tract is concerned

only with light touch and the posterior columns concerned with deep sensibility of position, vibration, etc. It follows then that interruption of these tracts in any portion will relieve pain in the involved area circumscribed by the involved nerve root. Therefore, section of the peripheral sensory nerve will temporarily relieve pain, although this nerve, of course, will regenerate. Postganglionic posterior root section will relieve pain in the involved dermatome and will not regenerate. Section of the spinothalamic tract at any level in the spinal cord will relieve pain on the opposite side from two segments below the level of the incision downward. Section of the spinothalamic tract in the mid-brain, so-called medullary tractotomy or mid-brain tractotomy will relieve pain at a higher level including the neck, shoulder and arm. Resection of the postcentral gyrus on the opposite side will therefore relieve pain in the areas which have been denervated.

The pathways of sympathetic afferent fibers which conduct sympathetic pain are almost as clear cut. Distention of a viscus, causalgic pain secondary to vasospasm in turn secondary to injured tissue or irritation of a peripheral nerve, may be relieved by sectioning the sympathetic nerve system with its connections at the appropriate level. This sympathetic surgery has not been refined enough to be carried into actual operative interference in the hypothalamus, the final seat of sympathetic impulses.

Whether the propagation of painful impulses is on a chemical, humoral or electrical basis is not as yet known. We suspect, in the sympathetic nervous system, that it is on a humoral or chemical basis since it has been shown that adrenalin and acetyl choline have been manufactured at sympathetic and parasympathetic nerve endings. In the peripheral or central nervous system, however, such a humoral aspect has not been demonstrated and it must be held, until further proof has been uncovered, that such transmission of painful impulses is on an electrical basis. This must be assumed because of the electrical activity of the postcentral gyrus demonstrated by electroencephalography on the exposed brain and the change in potential accompanying the wave of propagation.

Neurosurgical Treatment of Intractable Pain

The conservative treatment of pain by medical means such as the use of opium derivatives, coal tar compounds, heat, snake venom and pitcher plant extracts (ammonium salts), does not constitute a part of the neurosurgeon's armamentarium nor can it be included in the treatment of intractable pain since if relief is obtained the pain is not intractable.

The value of neurosurgical relief of intractable pain lies in the treatment of those unfortunates suffering from malignant disease. If conservative medication has failed and the patient has a life expectancy exceeding a period which has been arbitrarily fixed at three months, he may be relieved by surgery. Many patients of comparatively long life expectancies but suffering from incurable disease and intractable pain receive opiates until they are confirmed addicts and become mental casualties. When this point has been reached it is useless to consider surgery for relief of the pain. The removal of the pain then no longer constitutes an excuse for the continuance of the drug and the patient's mental outlook becomes hopeless. Marked mental depression and suicidal tendencies are encountered. The prolonged use of opium derivatives, therefore, is condemned unless life expectancy is short.

Interruption of afferent nerve pathways at selected points, properly performed, will give relief of pain. Standard neurosurgical methods may be classified under the general headings outlined below:

I. Injections of novocain and alcohol
   - A. Local
   - B. Paravertebral
   - C. Caudal
   - D. Intrathecal

II. Posterior Rhizotomy

III. Chordotomy

IV. Mesencephalic Tractotomy

V. Resection of the Postcentral Gyrus

VI. Sympathectomy

VII. Prefrontal Lobotomy

It has been noted following the work of LeRiche, and later Livingston, that local infiltration of the painful area, with nothing more than novocain, sometimes gives more than temporary relief. In some cases, Homan has been able to accomplish, with novocain, the equivalent of a periarterial sympathectomy. These procedures have a limited applicability and have been largely superseded by paravertebral novocain or alcohol blocks.

Paravertebral blocks again have a limited application and are useful only in giving temporary relief of a sympathetic type of pain. It has been noted, however, that repeated paravertebral blocks sometimes give more than temporary relief and on occasion have given permanent or semi-permanent relief. Also it has been noted that following the demonstration of relief by novocain, the injec-

tion of alcohol through the same needle may give permanent relief. Paravertebral alcohol injections, however, constitute occasionally a hazardous procedure since an area of necrosis situated next to the aorta or vena cava might prove disastrous. Caution is therefore urged in the use of alcohol in the paravertebral region.

The technic of paravertebral injection is comparatively simple. Three spinal needles are placed along the anterolateral surface of the involved body of the vertebra and a few cubic centimeters of 1 per cent novocain are forced through the needle after preliminary aspiration. The effectiveness of the paravertebral block can be easily ascertained by the increased skin temperature and lack of sweating on the affected side. In the case of a cervicodorsal sympathetic block, demonstration of a Horner's syndrome is proof of sympathetic paralysis.

Caudal novocain anesthesia has become less and less popular since causes of idiopathic sciatic neuritis are becoming less frequent. It has been found that so-called idiopathic sciatica almost invariably means mechanical pressure upon a nerve root, just as any mononeuritis usually means such mechanical pressure. Since the increasing popularity of protruded intervertebral disc syndrome, we rarely see a true case of sciatic neuritis. However, if such a diagnosis is made, caudal anesthesia, using 1 per cent novocain, through the sacral canal, will give not only temporary relief but occasionally permanent relief.

The use of intrathecal alcohol is becoming less and less favored, although, in the treatment of intractable pain caused by malignancy, particularly bilateral pelvic pain caused by midline malignancy, it has its advocates. Alcohol has an affinity for the posterior nerve roots carrying afferent pain impulses. The alcohol rises to encompass the posterior roots with the patient in a prone position. The patient may be turned from side to side to get both posterior roots to ensure anesthesia on both sides.

The technic is as follows: The spinal cord segment is elevated by means of a sandbag. Three spinal needles are inserted in the subarachnoid space by means of the closed puncture method so that the spinal cord will not be injured. Four-tenths of one cubic centimeter of absolute alcohol is then injected slowly into each needle. Thus the total of 1.2 cubic centimeters of absolute alcohol is infiltrated about a raised level of the spinal cord from which the three involved neural segments emanate. The posterior roots are bathed with alcohol and, because they have no neurilemmal sheath, their fibers are destroyed. This is a postganglionic destruction and is therefore permanent. The dangers inherent in the use of absolute

alcohol in the subarachnoid space are those of loss of bladder control and occasional paresis of an extremity. This responsibility should therefore be left to the specialist.

Posterior rhizotomy for the relief of either somatic or visceral pain has a wide range of usefulness, within certain limitations, and occupies a definite place in the neurosurgeon's armamentarium. Its applicability, however, is decreasing since painful areas may outgrow the boundaries of the areas delimited by the severed posterior roots. Posterior rhizotomy in the cervical region is impractical because of the great disability of the hands which results. Posterior rhizotomy of the roots of the cauda equina has never been a particularly satisfactory procedure and should not be done in the author's opinion. The main value of posterior rhizotomy lies in the treatment of radiculitis involving dermatomes of the trunk. It may be caused by old fractures, arthritis, postherpetic neuralgia and allied disorders.

Posterior rhizotomy of the fifth or trigeminal nerve is of course the accepted method of treatment of tic douloureux or trigeminal neuralgia, as well as ninth nerve or glossopharyngeal neuralgia. These procedures in qualified hands are comparatively safe and simple.

It seems rational to precede the treatment of carcinoma of the tongue, as well as other malignant disorders of the face and pharynx, by relief of pain so that various otherwise painful therapies may be accomplished in the heroic fashion necessary for the control of the disease. Pain in this area can be relieved by ninth nerve section on the affected side followed by injection or section of the ipsolateral trigeminal nerve.

The technic of posterior rhizotomy is a rather complicated, delicate one and should be left for the neurosurgeon. It consists of a laminectomy over the proper spinal segment, the opening of the dura and arachnoid and sectioning the posterior roots between the ganglion and the spinal cord of the affected radix. It goes without saying that rhizotomy of the fifth or ninth cranial nerve constitutes an intracranial operative procedure which is highly technical and which should be left for the neurosurgeon.

The main value of *chordotomy* lies in the treatment of pain caused by malignancy and should be reserved for that pain which is intractable and severe. Chordotomy consists of a permanent obliteration of afferent impulses and therefore causes a permanent anesthesia to pain and temperature on the contralateral side from the level of the chordotomy down. While it is not a mutilating operation and does not carry great danger of paralysis or loss of bladder

control, this has occasionally been seen. The decision, therefore, should be weighed carefully and mature judgment should be brought to bear upon the problem. While the operation is not formidable and carries a very low mortality rate, and is the operation of choice in the control of pain due to malignancy, it is not the operation of choice in other painful conditions which might be treated more conservatively.

The technic consists of a laminectomy, opening the dura mater, carefully delineating the lateral spinothalamic tract in the anterolateral portion of the spinal cord and then incising through this tract in the proper fashion.

Mesencephalic tractotomy has been described in detail by Schwartz and Walker. This is a highly technical procedure which is a more formidable operation and carries a higher mortality and should be reserved for intractable pain due to malignant disease of the neck, shoulder girdle and sometimes of the upper extremities. It consists of severing the spinothalamic tract in the mid brain or in the medulla. This procedure has become fairly popular among qualified neurosurgeons but it has not as yet attained widespread use, probably due to the detailed knowledge of anatomy, physiology and technic that is required.

Resection of the postcentral gyrus of the cortex of the brain has a limited field of usefulness but gives excellent results in two notoriously resistant conditions. Phantom limb pain, that is persistence of the sensation of a limb which is painful after amputation, and postherpetic neuralgia, a particularly painful and notoriously resistant condition. Resection of the postcentral gyrus should be reserved as the final procedure to be considered for the relief of pain when other methods have failed. The mortality of the procedure is low and the technic is fairly simple although highly delicate and requiring mature judgment. It is to be thought of as the last resort in the hierarchy of the treatment of intractable pain. It is well to realize, however, that phantom limb pain and postherpetic neuralgia seldom respond to any other treatment.

The value of *sympathectomy* in the treatment of causalgia and other sympathetic afferent pain cannot be overestimated. The question as to its applicability can be determined easily by the procedure of paravertebral novocain injections. If the paravertebral injection gives temporary relief, then it can be assumed that sympathectomy will give permanent relief.

Painful extremities due to Buerger's disease (thromboangiitis obliterans), Raynaud's disease, causalgia and erythromelalgia respond nicely to sympathectomy. Persistent incapacitating arthri-

tides, particularly hypertrophic spondylitis with resulting incapacity and pain, may sometimes be benefited by the judicious use of sympathectomy.

Phantom limb pain described above should be treated in the beginning, first by the resection of any neuromas that have been found, secondly by paravertebral block and thirdly by an actual sympathectomy if the paravertebral block gives temporary relief. A spinal anesthetic will then determine whether a chordotomy will give relief. If a chordotomy does not give relief, resection of the postcentral gyrus is the next logical step.

The pain found in brachial neuralgias, excluding the obvious arthritides, bursitis and myositis, can be subdivided into the neuritis caused by an anterior scalene syndrome or cervical rib and the pain caused by cervical herniated intervertebral disc. Both are due to mechanical pressure upon the nerves and the nerve roots and the surgical procedures for the relief of each are fairly simple and carry little or no mortality.

Recently, the author has been able to describe a *unilateral type of headache* akin to or a variant of migraine headache caused apparently by pain referred along the temporal artery, probably along afferent sympathetic nerves. This pain has been relieved by resection of the temporal artery and occasionally the occipital nerve.

Various typical facial neuralgias have been most resistant to treatment but a great many of them have begun to fall into this category of vascular headaches.

One of the greatest and most recent advances in the treatment of intractable pain has been that of *prefrontal lobotomy* which apparently allows the patient to become no longer cognizant of or concerned with the pain which still exists. Obviously, section of the frontothalamic tracts carried in the white matter of the frontal lobe will relieve the patient of emotional tension, stress and social problems. It also will allow that patient to become calm and placid and not actually concerned with the pain which formerly had been causing great mental distress.

For this reason, the use of prefrontal lobotomy for the relief of intractable pain has become very popular. The same indications for surgery should be followed in this case as those to be followed for chordotomy or other drastic surgical procedures. It is of interest to note that some authors have even found that unilateral prefrontal lobotomy will give relief of ipsolateral, contralateral or bilateral pain. This, however, has not been found in all clinics and it seems wise, therefore, to do a complete bilateral prefrontal lobotomy, which carries no great mental deficit with it, for the relief

of intractable pain. The author has had considerable success in this method and recommends it most highly for such pain accompanied by great mental distress and anxiety.

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SURGICAL ASPECTS OF THROMBOPHLEBITIS

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During the past decade there has been tremendous interest in venous thrombosis and its complications. This is not a new disease but one long feared in surgery which is accompanied by bed rest. Actually postmortem figures show that fatal pulmonary embolism occurs as often in medical patients confined to bed.[1] Frequently severe and sometimes permanent disability of the extremity results. Two things that have stimulated recent interest are: (1) better diagnosis and (2) newer technics of effective therapy.

This paper is concerned with 27 cases of deep thrombophlebitis treated during the past 3 years. The common types are represented and, for the most part, occurred in surgical patients. From this list the major features of the disease will be outlined as well as its treatment.

Women outnumber men 2 to 1: of the 27 patients, 18 were female, 9 were male. There were 6 colored patients and 21 white. The ages ranged from 23 to 71, with the majority between 30 and 60, the average age being 44. The left lower extremity was affected nearly four times as frequently as the right. This is thought to be due to the anatomy of the common iliac veins. Pulmonary embolism occurred in 4 of the 27 cases, being the initial symptom in 3 of the 4. No deaths occurred.

Thrombophlebitis may be defined as clotting of the blood within a vein with accompanying inflammatory change. Sometimes the process is "silent" and a loose floating clot forms with great likelihood of its breaking off and being carried to the heart. At other times the deep vein is rapidly blocked by a clot which adheres to its lining and a marked perivascular reaction occurs. Sympathetic vasospasm accompanies this as well as edema, cyanosis, and pain. Many writers attribute the inflammatory reaction to infection but it is more likely that it is due to interference with the blood supply to the vein wall by the occluding clot and to vasospasm. Some authors, notably Ochsner of New Orleans, have stated that there are two distinct diseases, "Phlebothrombosis" and "Thrombophlebitis," with different etiology, clinical course, and therapy.[2] With this in mind, an attempt was made so to divide the present 27 cases:

"Phlebothrombosis"	10	Emboli	2
"Thrombophlebitis"	13	Embolus	1
In Between Cases	4	Embolus	1

It was found that it was very difficult to separate two distinct

groups. Equally present throughout were all the usual etiologic and clinical features and the only differences noted were degree of inflammation and vasospasm and the speed of its development. There was a definite impression gained that the 27 cases represent different stages of the same disease, all of which rarely are seen in the single case, but which occasionally progressed from one to the other.

Some of the etiologic factors were considered. It is generally agreed that the most important are slowing of the circulation in the lower extremity and increased tendency for the blood to clot.

Postoperative	23
Varicose Veins	2
Intra-abdominal Infection	1
Healthy Ambulant Female	1

The effect of circulatory stasis is brought out by several factors: 23 out of 27 cases developed phlebitis while confined to bed. When the surgical figures are broken down, it is seen that the lower abdomen, pelvis and extremities make up the group.

In the 23 postoperative cases, the operations were as follows:

Pelvic Surgery	11	Ambulant	1
Urologic	6		
Hernia	2		
Vein Operations	3	Ambulant	1
Compound Fracture	1	Ambulant	1

This is further brought out in an analysis of 3 comparable series of cases done in the same period:

Pelvic Operations	69	Phlebitis (Embolus-1)	5
Thyroidectomy	96	Phlebitis	0
Radical Mastectomy	30	Phlebitis	0

This would indicate that length of operation, anemia, hemorrhage, blood transfusion, and anesthesia, play little rôle in causing phlebitis. All forms of anesthesia were used without noticeable difference.

Age of the patient may be an influence due to greater activity of the young and their faster circulation time.

In late 1946 the author adopted early mobilization and early ambulation in all types of major surgery, including particularly pelvic surgery. Since that time only one mild case of phlebitis following abdominal hysterectomy has occurred where there were 4 in the year preceding in patients kept in bed a week or longer.

The second major etiologic element, increased tendency to clot, is more difficult to bring out. However, it is known that coagula-

tion time is reduced following injury, hemorrhage, or operation. The platelets are increased, have a greater tendency to clump, fibrinogen is increased and thromboplastin may be released from the damaged tissue into the blood stream.[3]

Under this heading, anemia of less than 75 per cent hemoglobin was found in about half the cases. This was secondary in type and may have been a contributing factor. Dehydration was not noted particularly in any case.

Infection was possibly present in mild degree in 7 cases and to a significant degree in only one. A number of cases occurred while penicillin was being given and a majority was given penicillin or sulfadiazine after thrombophlebitis developed without demonstrable effect. Septic fever and leukocytosis were also lacking. From these cases it is not evident that infection plays a significant rôle in either mild or severe thrombophlebitis.

Prophylaxis

The prevention of thrombo-embolism may be accomplished in several ways. General measures should be used, such as correcting anemia and dehydration and improving the circulation, encouraging early active motion and elevating the lower limbs until this is possible. As shown above, certain types of surgery predispose to phlebitis and this is more likely in the older age group. Therefore, it should be possible to anticipate the occurrence of venous thrombosis.

Here two schools of active therapy exist. One believes that bilateral femoral vein ligation should be practiced in patients over 65 before major surgery. Allen and associates at the Massachusetts General Hospital treated 458 patients by prophylactic ligation with thrombophlebitis developing in 5 and fatal embolism in one. A control group of the same number had 55 cases of thrombosis and 26 fatal emboli.[4] It has been shown by Linton in 1000 femoral vein ligations that there was practically no disability, and no mortality from the procedure.[5] No prophylactic ligations were done in this series but it is believed to be a sound procedure and should be done more often where anticoagulants are not available.

The second school believes in prophylaxis with the anticoagulants, heparin and dicumarol. The blood can be carefully kept in a condition where neither hemorrhage nor intravascular clotting is likely to occur. E. V. Allen of the Mayo Clinic reports the use of dicumarol in 398 patients, 114 of whom had had a previous thrombosis or embolism, without a single recurrence. In 716 cases of hysterectomy there were 2 cases of minor phlebitis and no embolism,

whereas 29 cases of phlebitis and 5 cases of fatal embolism might have been expected.[6] Cosgriff, Cross, and Habif at Presbyterian Hospital, New York City, treated 51 cases, 25 of whom had had previous thrombo-embolism, with dicumarol with no embolic phenomena and only one mild venous thrombosis in a case in which therapy was not adequately maintained.[7]

One of the present series had to have a subsequent nephrectomy, and was given dicumarol postoperatively without recurrence of phlebitis. Of the two, anticoagulant therapy appears more practical and more successful than prophylactic ligation, but it must be carefully controlled by accurate and repeated blood prothrombin time and determinations. In cases where it was used, the effect on the prothrombin time of a given dose was unpredictable as was the length of time the effect persisted. It should be used carefully or not at all in liver disease, blood dyscrasias, kidney disease, bleeding diseases and neurosurgery.[1,6]

Treatment

When venous thrombosis has occurred it has been fully demonstrated and was seen in this series that active therapy will cause the disease to subside, reduce disability, and greatly lower the incidence of embolism. Which form this therapy should take depends on the stage of the disease. Vein ligation, anti-coagulants and sympathetic nerve block all have a place and are often best used in combination.

1. When pulmonary embolism has occurred and mild thrombophlebitis found, ligation of the superficial or the common femoral vein should be done at once, and anti-coagulant therapy started. Most authors feel that ligation should be bilateral, particularly if anti-coagulants are not used with ligation.

2. When iliofemoral thrombophlebitis is well established and embolism occurs, the trend over the country seems to be more toward anti-coagulants than toward iliac and venacaval ligation. However, in cases of repeated embolism or suppurative thrombophlebitis, this type of ligation should be done. The anti-coagulant therapy of embolism should begin at once with heparin, to be continued later with dicumarol or heparin. Heparin may be given in intermittent intravenous doses or the long-acting form of Pitkin's menstruum can be used until the dicumarol effect takes place.

In the present series, 4 of the 27 patients had pulmonary embolism. Two were treated by ligation, one by heparin-Pitkin and

dicumarol, and one by dicumarol alone with nerve blocks. There were no further emboli and the phlebitis subsided in every case.

Treatment in 27 cases:

ANTICOAGULANTS	21	ALONE	9
NERVE BLOCK	16	ALONE	4
LIGATION	3	DICUMAROL	2

The combination used most often was sympathetic nerve block, plus dicumarol. This was done in 12 cases and was found to give quickest relief of symptoms and restoration to normal.

3. In the cases of advanced thrombophlebitis involving the iliofemoral vein as well as the leg, there was accompanying inflammation and severe sympathetic nerve spasm. In these, the pain can quickly be relieved and the circulation to the extremity improved by blocking the first four lumbar sympathetic ganglia with 1 per cent procaine. This technic has been followed as advocated by Ochsner and DeBakey with gratifying results.[8] As part of the treatment, the limb is elevated quite high and ice bags are placed on the upper femoral and calf veins if tender. In mild cases, the leg is firmly wrapped with an elastic bandage and the patient is allowed to exercise the foot and leg in this position. When fever and tenderness have subsided the leg is gradually lowered and after 5 days ambulation is begun while dicumarol is continued. If pain returns the limb is again elevated. Anti-coagulant therapy is continued until all pain and tenderness are gone. If swelling persists, elastic bandages and intermittent elevation are practiced as long as necessary to regain good function.

CASES	27	RESULT
EARLY	10	EXCELLENT
ADVANCED	13	FAIRLY GOOD
LATE	4	FAIR

The success of treatment in restoration to normal and prevention of chronic congestion of the leg was proportional to how early in the disease treatment was instituted. Early cases, so-called "phlebothrombosis," quickly returned to normal. Moderately advanced thrombophlebitis was slower but finally became quiescent with mild residual swelling. Cases where severe thrombophlebitis has been present for some time and which show the late swollen limb are very hard to improve by any therapy. However, it has been observed that these cases show persistent or recurrent pain and tenderness over the veins and vasospasm. These are improved by lumbar sympathetic nerve blocks and sometimes dicumarol therapy, suggesting that the actual disability is due to chronic residual phlebitis. The mechanical congestion of the limb is a difficult prob-

lem and requires intermittent elevation and elastic support. If edema is not allowed to develop and become chronic, the leg will recover sooner and there will be less permanent disability.

Summary and Conclusions

1. The subject of thrombophlebitis as related to surgery has been reviewed and a series of 27 cases has been used to illustrate features of the disease and its treatment.

2. Pathologically the processes are the same although the various forms or stages that the disease may take have different clinical implications.

3. The important etiologic agents are slowing of the circulation and increased coagulation tendency of the blood. This is more likely to occur in the presence of anemia and after lower abdominal operations, especially in the middle and older age groups.

4. Prophylactic treatment is quite possible and effective and should be used more often in cases which have a greater likelihood of developing phlebitis.

5. Active treatment of both the disease and its complications is on a well established basis and should be carried out early. If done, the mortality will be greatly reduced, as well as the prolonged disability that often occurs in cases treated symptomatically.

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DISEASE OF THE EPIPLOIC APPENDICES

Report of Two Cases*

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Appendices epiploica are pedunculated fatty appendages of various sizes formed by reduplication of the peritoneum which enmeshes fatty tissue between its layers. They are arranged in relation with the anterior surface of the entire large intestine, occasionally the cecum and even the vermiform appendix giving origin to some, but none are found in the rectum. The total number varies but averages about 100, and they are usually more numerous in the transverse and pelvic colon.[2]

As Marbury and Jackson[4] remark in their recent review of this subject, "Epiploic appendix disease holds a lowly place in surgical consciousness and also in medical literature, largely because of the comparative rarity of the condition." They go on to refer to Porter[5] who in 1943 could find only 60 cases reported in the medical literature.

Boyd[1] states that the chief pathologic conditions are torsion, acute inflammation, detachment, and adhesions; that all are rare; that torsion usually occurs in abnormally long appendices epiploicae loaded with fat; and that acute inflammation is more uncommon than torsion. Christopher[2] summarizes the chief lesions as mechanical interference with the blood supply by direct pressure or torsion, infection incident to interference with the blood supply or to diverticulitis, and adhesions.

The symptoms are those of an acute abdominal condition and vary in severity with the acuteness of the onset. The course of the disease may be quite serious and may even lead to a fatal termination. If the inflammation or torsion is less acute or if surgical treatment is resorted to early, the course is likely to be more benign. It is probable that many benign cases recover spontaneously, or are overlooked at the time of operation. Karstner,[3] in discussing appendices epiploicae, states that there are infrequent instances of torsion and infarction with symptoms of acute abdominal inflammation which resemble those of acute appendicitis and that rarely these are followed by abscess formation and diffuse peritonitis.

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The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large. J. S. Brown, Jr.

Case Reports

Case 1. J. W. B., a 37 year old technical sergeant of the Marine Corps, was admitted to the hospital on Sept. 9, 1948, complaining of pain in the right side of his abdomen. The present illness had begun four days previously at about 8 o'clock in the morning, after a usual breakfast. He then noticed a dull pain and soreness in the right lower part of his abdomen. This pain had continued without much change in character, severity, or location. There had been no anorexia, nausea or vomiting, and no marked interference with sleep. There had been no change in the character of the stools, or in the normal bowel habits. The white blood count taken on two occasions during the present illness was reported to be 8,000 total cells with 72 per cent segmented cells. There had been no previous similar attacks.

Physical examination revealed a well developed, somewhat obese, white male, height 71 inches and weight 194 pounds. His pulse, temperature, and respirations were normal. General examination was normal except for the abdomen, which showed a well localized tenderness in the right lower quadrant. The cecum was palpable and tender, but there was no rebound or referred tenderness. His abdomen was soft and there was no muscle guarding. Rectal examination was negative.

A definite diagnosis was not made, though amebiasis and subacute appendicitis were considered. On the following morning (September 10) the symptoms and findings remained about the same, and the patient had slept fairly well. However, the white cell count had risen slightly, to 10,600 total cells with 78 per cent segmented cells. An appendectomy was considered advisable.

Operation: Under spinal anesthesia the abdomen was opened through a transverse right lower quadrant incision (Davis-Elliot). The appendix appeared to be grossly normal and was excised in the usual manner. The cecum was somewhat bound down and not very mobile. Just above the ileocecal junction, and plastered to the anterior surface of the upper cecum by a thin plastic exudate, was found a small (.5 cm. in diameter) epiploic process, dark and meaty-looking from a recent hemorrhage. It was easily freed, its pedicle ligated, and excised. It was noted that the omentum, abdominal wall, and all tissues were rather heavily infiltrated with fat.

His postoperative course was smooth, except for abdominal soreness being worse than was to be expected for a few days. His temperature was not elevated. He was allowed out of bed on the evening of the operative day. Sutures were removed on the seventh postoperative day, and he was returned to full duty thirteen days after operation.

The pathologic report showed an essentially normal vermiform appendix, and an epiploic appendix showing hemorrhage and active chronic inflammation. Sections of the epiploic process showed the margins to be hemorrhagic. The peritoneal surface was covered with a thin layer of fibrinous exudate, infiltrated with acute and chronic inflammatory cells.

Case 2. H. N. S., a 28 year old technical sergeant of the U. S. Marine Corps, was admitted on Sept. 17, 1948, complaining of abdominal pain. He had had slight intermittent pain in the lower part of his abdomen for several days, like mild gas pains. This morning he was awakened about 4 o'clock by a rather sharp pain, like a gas pain, localized in the right lower quadrant of his abdomen. He had had no nausea or diarrhea, and he had never had any

similar attacks previously. The pain has persisted but now is more of a sore ache in the same location and is not at all bad while he is lying down.

Physical examination revealed a heavy-set white male, height 72 inches and weight 197 pounds. Temperature, pulse, and general examination were normal. The abdomen was rather obese and was tender about the umbilicus and over the cecum but not severely so. It was soft and there were no palpable masses. The white blood count was 10,900 total cells with 59 per cent segmented cells.

It was thought that he probably had an acute mesenteric lymphadenitis, and no specific treatment was instituted. On the following morning (September 18) his right lower quadrant was still sore and he had had some pain through the night, but no nausea. His white count had increased to 12,000 total cells with 76 per cent segmented cells. With the persistence of pain, a low grade appendicitis was considered to be the probable cause and surgery was advised. Under spinal anesthesia the abdomen was opened through a right lower quadrant transverse incision and a grossly normal vermiform appendix was excised. Flattened against the anterior surface of the cecum at the level of the ileocecal junction was a hemorrhagic epiploic appendage, dark red and meaty in appearance and about 1 by 2 cm. in size. The pedicle was ligated and it was excised. All tissues were noted to be markedly infiltrated with fat.

Toilet privileges were permitted on the day of operation. On the first postoperative day he was rather uncomfortable, his abdomen was mildly distended, and his temperature rose to 101 F. Penicillin therapy was begun, and the next day he felt better and his temperature did not go above 99 degrees. Convalescence continued uneventfully, his sutures were removed on the seventh day, and he was returned to full duty on the thirteenth day after operation.

The pathologist reported an essentially normal vermiform appendix, and a mass of mature adipose tissue showing hemorrhage and active chronic inflammation. Sections of the epiploic process showed many small hemorrhagic areas and portions of the surface were covered with thin layers of fibrin and were infiltrated with acute and chronic inflammatory cells.

Comment

In the two cases reported here, the symptoms were those of a low grade appendicitis. In the second case, admitted only a week after the first one, the correct diagnosis was considered before operation but it was thought to be very unlikely, due to the rarity of the condition. Both patients were of very similar build and general physical appearance, and were somewhat obese. The history of onset and the clinical findings were similar in both cases, and the findings at operation were much alike. In neither case was evidence of torsion present. Perhaps a sustained posture while asleep caused enough pressure interference with the poor blood supply to cause local infarction and a low grade inflammation (each appendage had only one small central artery and vein). In support of this theory was the appearance of the affected appendages at operation, looking as if they had been plastered or pressed against the intestinal wall. It will be noted that the second case had an unexplained postopera-

tive temperature rise to 101 degrees. This may have been due to the larger size of the appendage in this case with a little more involvement of the contiguous surface of the bowel.

Summary

1. Disease of the appendices epiploicae has been infrequently reported in the literature, but probably occurs in mild form more often than it is diagnosed.

2. In cases of suspected appendicitis where the vermiform appendix appears to be normal or questionably involved, this condition should be borne in mind for further exploration.

3. Two cases of inflammation of the epiploic appendages are reported, in both of which the disease was probably caused by mechanical interference with the blood supply.

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SEVERE TETANY WITH LARYNGOSPASM AND PROLONGED COMA FOLLOWING THYROIDECTOMY

Report of a Case

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HYPOCALCEMIA and parathyroid tetany following surgery is certainly not a new subject and is a condition which was seen with relative frequency in the early days of thyroid surgery. The advances made in the last two decades in both the preparation of the toxic patient and in operative technic have reduced the incidence of this complication in its severe form to that of a surgical rarity. MacBryde[1] gives an incidence of 1.5 to 0.5 per cent; Haines,[2] however, states that hypoparathyroidism occurs in only 0.05 per cent of cases following partial thyroidectomy for goiter. He further points out that laryngeal spasm rarely occurs as a manifestation of hypoparathyroidism unless one cord is paralyzed by injury to the recurrent laryngeal nerve. Hypoparathyroidism following surgery may be due to: (1) removal of the parathyroids, (2) damage to the circulation or other mechanical interference to the glands, or (3) rarely, inflammatory changes secondary to operated thyroiditis.

The development of dihydrotachysterol (AT10) for the treatment of these unfortunate cases has produced dramatic amelioration of symptoms and has made control of the hypocalcemia and hyperphosphatemia a relatively simple and satisfactory therapeutic régime. This is in striking contrast to the inadequate and ineffective measures used previously, with the hapless patient dragging out a miserable existence and all too often going progressively downhill in spite of the most vigorous treatment.

The case we are reporting here presents a number of unusual features in both the onset of the condition and its subsequent course. Management has been extremely difficult and only fairly satisfactory to date and it is felt that a brief review of the problems encountered may be of some value.

REPORT OF CASE

History: Mrs. R. J., a 26 year old, married, white female, was first seen in the office May 11, 1948. She complained of nervousness, palpitation, weakness, and emotional instability of approximately 6 months' duration. She had lost only 6 pounds in weight, but stated that she had never weighed over 89 pounds. She had undergone a cesarean section in November, 1947, without incident, and had an appendectomy in April, 1948. At the time of the latter

operation, her doctor had noted an enlarged thyroid gland and advised treatment. Other than the palpitation and weakness mentioned, system review was not remarkable.

Physical examination: Examination revealed a very small, poorly nourished young woman, weighing 83 pounds. She appeared quite apprehensive, but not acutely ill. A moderate degree of exophthalmos was present.

Both lobes of the thyroid gland were diffusely enlarged, and a small nodule was present over the isthmus. No thrill or bruit was present. The heart was of normal size with a regular sinus rhythm and no murmurs. The pulse rate was 140 and blood pressure 146/98. The outstretched hands revealed a fine tremor. Definite quadriceps weakness was demonstrated.

The basal metabolic rate was plus 58 per cent. Other laboratory work was not remarkable except for a mild anemia.

A diagnosis of hyperthyroidism was made and the patient was prepared for surgery with propylthiouracil on a dosage schedule of 50 mg. every 8 hours. Two weeks prior to surgery this drug was discontinued and 30 drops of Lugol's solution daily was administered.

She was admitted to the hospital Sept. 14, 1948, at which time the basal metabolic rate was plus 21 per cent, pulse rate was 100, and weight 87 pounds. She had been symptom-free for 4 weeks prior to admission, and in spite of the persisting elevation of basal metabolic rate and pulse, it was felt that she was ready for operation.

On September 16 a subtotal thyroidectomy was done under pentathol sodium and cyclopropane anesthesia. Practically all of the right lobe and four fifths of the left lobe were removed by intracapsular dissection without incident. The recurrent laryngeal nerves were identified and examinations of the specimen at the table failed to show any evidence of parathyroid bodies. The pathologic report was "hyperplasia of thyroid gland." No parathyroid tissue was found, although a careful search was made and sections prepared and studied from all suspicious areas.

Course: The first 24 hours following operation were uneventful except for a slight amount of bleeding from the incision and formation of a small hematoma on the right. About 3:30 p.m. on the first postoperative day, she complained of some difficulty in breathing. There was no numbness, cramping, carpopedal spasm or other signs of hypocalcemia. It was felt that the dyspnea was due to pressure from bleeding within the wound; accordingly the incision was partially opened and a few c.c. of blood and serum evacuated. When this failed to relieve the symptoms, thorough exploration of the wound in the operating room was decided upon. While the patient was being transferred to a stretcher, she suddenly ceased to breathe and became intensely cyanotic. No heart action could be heard and to all appearances she had expired. An immediate trachectomy was done and artificial respiration administered. Five c.c. of coramine and 1 c.c. of adrenalin were given intravenously. The heart action became perceptible within two to three minutes and the patient began to breathe shortly thereafter. Five minutes later a generalized convulsion with carpopedal spasm occurred. Thirty c.c. of calcium gluconate and 10 c.c. of calcium chloride given intravenously over a 35 minute period failed to control the spasm and finally 5 c.c. of a 2 per cent solution of pentothol sodium was given. Immediately following trachectomy oxygen had been begun through a catheter placed in the trachea and this was continued throughout the entire

convulsive period. The patient was then placed in an oxygen tent and given penicillin, streptomycin and 100 units of parathyroid extract intramuscularly. At 4:30 a.m. a severe convulsion occurred which was relieved by 10 c.c. of calcium chloride intravenously. The following morning the blood calcium was reported as 7.9 mg. per cent; another 100 units of parathyroid extract was given intramuscularly and 10 c.c. calcium chloride intravenously. The patient had remained in a deep coma; Chvostek's and Trousseau's signs were strongly positive. The blood calcium at 4:00 p.m. the same day was reported as 10 mg. per cent, but no improvement in the comatose condition or signs of latent tetany occurred. Transfusion of 500 c.c. of whole blood, intravenous glucose and other routine supportive measures were carried out during the ensuing 2 day period. The patient began to show signs of regaining consciousness the night of September 20, approximately 72 hours after the onset of tetany. During the following 48 hours, she became completely oriented, but her behavior was child-like and she had little voluntary muscular control. On September 22, treatment with 1 c.c. AT10 (dihydrotachysterol) and 8 Gm. calcium lactate daily was begun. On September 26, the trachectomy tube was removed and ambulation was instituted. The patient's course was thereafter progressively uphill and she was discharged October 7. At the time of discharge, Chvostek's and Trousseau's signs remained strongly positive in spite of a blood calcium level of 10.2 mg. per cent. Blood levels of calcium had ranged from 7.2 to 12.3 mg. per cent and of phosphorous from 3.3 to 7.05 during the period following the onset of tetany.

Before leaving the hospital, both the patient and her husband were instructed how to perform the Sulkowitch test for urinary calcium. It had been decided, in view of the obvious unreliability of the blood calcium reports, to follow the teachings of Albright[3] and manage her case by use of this simple test for calcium in the urine. This procedure has eliminated the necessity for frequent blood calcium determinations, thereby greatly simplifying her home management.

After returning home, the patient's course has been characterized by periods of smooth sailing with near normal activities and normal urinary calcium alternating with stormy periods of weakness, extreme nervousness and lack of self confidence, muscle irritability and rapid fluctuations of her urinary calcium from zero to a heavy precipitate indicating a blood level of 11.5 mg. per cent or above. A definite relationship between her menstrual periods and these periods of calcium balance has been observed. Respiratory infections, worry and emotional disturbances connected with her family life likewise produce an acute exacerbation of the signs and symptoms of chronic tetany. Her initial home treatment consisted of a low phosphorus diet; dihydrotachysterol 15 drops daily; calcium lactate, 2 teaspoonsful, and ammonium chloride 20 gr. 4 times daily. On Nov. 1, 1948, the Sulkowitch test showed a definitely heavier precipitate in the patient's urine than that of a control. Accordingly, in spite of a persisting faintly positive Chvostek's and Trousseau's signs the ammonium chloride was discontinued and the dosage of AT10 cut to 10 drops daily. This dosage proved to be inadequate, as demonstrated by increasing weakness, tremor, general malaise and a much fainter precipitate in the urine on testing with the Sulkowitch reagent. The dose of 15 drops daily was then resumed, but failed to produce a satisfactory response and has gradually been increased to 20 drops daily, which the patient is taking at the present time. The calcium lactate dosage is now varied from 2 to 6 teaspoonfuls daily according to the urinary calcium in an attempt to cope with the fluctuations produced by menstruation and the other factors described above.

At the time of writing this report, February, 1949, the patient weighs 91 pounds, is mentally alert and cooperative, but subject to periods of depression and greatly lacks self-confidence. No signs of myxedema have appeared and the pulse rate consistently runs between 90 and 100. The nails are pliable and no growth changes have occurred. Laryngoscopic examination shows no evidence of cord paralysis. Her appetite is good and she has suffered no gastro-intestinal disorders. Because of her very limited means economically, frequent laboratory procedures have had to be avoided and management has been almost entirely based on clinical signs and the results of the Sulkowitch test. On Feb. 23, 1949, the blood calcium level was 9.3 and blood phosphorus 3.6 mg. per cent.

Comment

A number of factors in this case are felt to be worthy of comment. In the first place, we cannot satisfactorily explain the cause of this severe case of hypoparathyroidism. The entire specimen was carefully examined by a competent pathologist, after tetany had occurred, with microscopic study of all suspicious areas without the discovery of any parathyroid tissue. Also, at the time of operation the entire posterior one-fifth of the left lobe was left in place to compensate for the radical removal of the right lobe. It is therefore hard to conceive that enough circulatory embarrassment to normally situated parathyroids could have been produced to bring about this severe form of hypoparathyroidism. We must, therefore, assume that the parathyroid bodies were chiefly on the right side and so situated within the thyroid tissue itself that they were not apparent either to the surgeons or to the pathologist.

Secondly, laryngospasm is a not uncommon manifestation of severe parathyroid tetany. However, in an incomplete review of the literature, we were unable to find a reference to a case in which it was the presenting symptom, totally without premonitory numbness, tingling, muscle cramps or spasm. The dyspnea occurring in this case was attributed by three examiners to be due to pressure on the trachea from a hematoma, because of the complete absence of any signs of tetany. Yet at the time of tracheotomy only a very small amount of blood was found to be present deep to the cervical fascia and the signs of laryngospasm were unmistakable. It has been pointed out earlier in this paper that, according to Haines, laryngeal spasm at any time is a rare manifestation of hypoparathyroidism in the absence of cord paralysis. Laryngoscopic examination has shown no impairment of cord function in this case.

Another point of interest and considerable concern at the time, was our inability to control the convulsions following tracheotomy with unusually large amounts of intravenous calcium (30 c.c. calcium gluconate and 10 c.c. calcium chloride). The theory that cerebral anoxia was a prime factor in producing the convulsions was

advanced at the time and discussed at length later. However, an adequate airway had been obtained and all cyanosis had disappeared within two to three minutes after the onset of severe symptoms and numerous cases have been recorded of considerably longer periods of anoxia without the appearance of convulsions.

The prolonged period of coma (72 hours) without localizing neurologic signs and without the abatement of signs of tetany in spite of normal blood calcium levels further confused the clinical picture. No changes in the pupils, pathologic reflexes or other signs of upper motor neuron damage appeared. During the first few days after the return to consciousness, the patient's child-like behavior and complete lack of insight strongly suggested frontal lobe damage. Fortunately, these signs have cleared completely.

The use of dihydrotachysterol (AT10) in the treatment of this patient may be briefly mentioned. Albright and his associates,[3,4] MacBryde,[1,5] Blum,[6] Rose and Sunderman,[7] and others have written extensively on the subject, and the dosage, the dangers and treatment of overdosage, the action of the drug, its clinical effect on hypoparathyroidism and the other aspects in its use in the treatment of these cases have been well covered in the literature. MacBryde[5] recommends an initial dose of 4 c.c., with 2 c.c. daily for the next several days and 0.5 to 1 c.c. daily as the blood calcium approaches normal. He states that an adequate maintenance dose varies from 0.5 c.c. 3 times weekly to 1 c.c. daily. Albright[3] suggests a daily dose of 3 c.c. until calcium appears in the urine and a maintenance dose of 3 to 5 c.c. weekly.

It is obvious that, according to these writers, our initial dosage was definitely too small, and this may well account for the unusual length of time required in this case for the signs of tetany to disappear. Our conservatism was due, of course, to the normal and high blood calcium levels which were present during the initial 2 weeks of treatment. Of greater interest is the fact that our maintenance dose, even though supported by large amounts of calcium lactate, has had to be increased to 1.3 c.c. daily, a figure considerably higher than required by other observers.

The exacerbation of symptoms, accompanied by a definite drop in urinary calcium which has been associated with menses, infections, and emotional disturbances has been a source of interest and concern. This phenomenon has been discussed by Blum,[6] Freyberg and associates,[8] and others in some detail. From a practical point of view, it indicates the necessity for close observation of the patient over an indefinite period of time, combined with education of the patient to a complete understanding of his condition and the impor-

tance of his close cooperation with his doctor. The management of such a patient closely simulates in general principles the management of a severe diabetic.

SUMMARY

A case of severe hypoparathyroidism following subtotal thyroidectomy is reported. A number of unusual features and problems in management of this case are briefly discussed.

Since this article was written, it has been necessary gradually to increase the dosage of AT10 to 1.8 c.c. daily in order to maintain normal urinary calcium levels and to control symptoms of tetany. The patient has learned to control exacerbations brought on by menstruation, excessive fatigue and respiratory infections by varying doses of calcium lactate (up to 4 teaspoonsful daily).

In addition to the above medication, it has been necessary to use transentine to control a persistent intention tremor, although this drug has not been required for the past several weeks. During exacerbations of symptoms reassurance and sedation have been called for. The basal metabolic rate on April 11, 1949, was plus 4. At the present time, one year after operation, the patient appears clinically well with no evidence of myxedema or chronic calcium deficiency. However, close observation over a period of several years is indicated before a definite statement can be made as to the success of dihydrotachysterol treatment for a case of this severity.

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THE SURGICAL APPROACH TO HYPERTENSION*

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IF one reviews the recent literature concerning hypertension, he finds that it is still a disease condition which in itself or by reason of its sequelae is a medical problem of great magnitude.

It is my own opinion that during the next few years we will see an upsurge in the number of cases of hypertension subjected to surgical procedures for relief of its distressing symptoms. Yet in some large clinics the number of cases has been small due to the very careful selection of cases. In this Clinic I have done a small series of cases.

Surgical procedures directed to the sympathetic nervous system were suggested as long ago as 1923 by Daniélopolu and by Bruning. It was largely the work of Craig, Adson, and Peet in this country that stimulated wide interest in the clinical study of hypertension and relief of symptoms by operations on the sympathetic nervous system.

The combined procedures of Craig and Adson consisted of resection of all the splanchnic nerves where they penetrated the diaphragm, with resection of the first and second lumbar ganglions, a portion of the celiac ganglion, and, in some instances, a portion of the adrenal gland. The surgical approach was subdiaphragmatic through a lumbar incision with resection of the twelfth rib. This approach allowed free exposure of the adrenal gland and the kidney.

Peet's operation is a one stage supradiaphragmatic approach with resection of a portion of the eleventh rib and removal of portions of the greater and lesser splanchnic nerves with the sympathetic chain from the ninth to the tenth and through the twelfth thoracic ganglion.

In 1938 Smithwick combined these two procedures through a transdiaphragmatic approach, removing portions of the sympathetic chain extending from the tenth thoracic through the second lumbar ganglion, including the splanchnic nerves.

During the past few years it has been the general consensus of those men actively engaged in this type of surgery that a more extensive removal of the sympathetic nerves is indicated. Grimson advocated transpleural complete sympathectomy.

Through a thoracolumbar approach Poppen removes from the

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fifth thoracic through the second lumbar by removing segments of the eighth and eleventh ribs without dividing the diaphragm. On the left side he removes ganglions up to the stellate ganglion in those patients with angina pectoris.

Hinton and Lord recently described an operative technic. In most cases the ninth rib is usually resected, thereby giving adequate exposure for the removal of the thoracolumbar chain from the third thoracic to the second lumbar inclusive with the entire greater, lesser, and least splanchnics. The diaphragm is divided. If the twelfth rib is long, the tenth rib is resected subperiosteally in its entirety. If the twelfth rib is short, the ninth rib is removed.

The anatomic description of these sympathetic structures and ganglions in almost all of the textbooks of anatomy is very sketchy. In my own limited experience with the Craig-Adson operation I have found considerable variation in the size of the splanchnic nerves and in the celiac ganglion and the lumbar chain. I have also noted some anomalies of position of the adrenal gland. In two instances where I was operating for renal calculi I found the adrenal gland overlying the mesial surface of the renal vascular pedicle. In one instance the renal vascular pedicle was very short, and the adrenal gland intimately attached to it by its own vascular pedicle, making it impossible to apply a rubber-covered clamp for control of bleeding in order to remove a large stag-horn calculus. Digital compression was only fairly satisfactory. A fragment of calculus was not removed, and a persistent fistula followed, requiring subsequent nephrectomy, most of the adrenal being removed with the kidney. I recently observed considerable variation in form and probably of size of the adrenal gland. In my opinion, in all probability the adrenal will again receive more attention in the treatment of hypertension.

In the study of hypertension many investigators have studied biopsy material from the kidneys obtained at the time of operation. The data obtained may be useful in arriving at a prognosis or in deciding whether the second stage of the operation should be done.

Smithwick and his associates from renal biopsy studies found that the severer the renal vascular disease, the more reduced the glomerular filtration rate and renal blood flow and that constriction of the efferent glomerular arterioles as represented by the filtration rate was not present in the early stages of renal vascular disease. They noted also that clinical hypertension and its grades of severity were ahead of the microscopic changes, that is, hypertension seemed to precede renal vascular disease, which appeared to be secondary to it.

The comparative value of skeletal muscle biopsy and renal biopsy is an interesting study. Some workers advocate the preoperative taking of a muscle biopsy. Foa, Foa, and Peet found that the findings correlate with blood pressure readings, changes in the eyegrounds, and clinical results. Kernohan, Anderson, and Keith were the first to suggest that hypertension could be graded by a skeletal muscle biopsy. Such a biopsy does not offer any information as to the origin of the hypertension, whereas a renal biopsy may furnish some definite information. Heyer and Keeton from their study of skeletal muscle biopsies of hypertensive patients concluded that, regardless of the origin of the hypertension, the histologic changes were the same: hypertrophy of the medial layer, constricting the lumen, and altering the lumen-to-wall ratio.

I am told that work now being done shows that the same information as to vascular changes found in the skeletal muscles of patients with hypertension can be demonstrated in sections of the skin.

Experimental and clinical studies the past few years have focused our attention again on the kidney as the cause of hypertension in certain cases. The urologist and urologic surgeon have formerly been concerned chiefly with the problems and complications of hypertension in patients undergoing treatment or operation for obvious urinary or genital disorders. At the present time the urologists are vitally concerned with studies that would show the relation of the kidney to a given case of hypertension.

The urologist will usually be concerned with three groups of cases: (1) those with known urinary tract disease and an associated hypertension, (2) cases of hypertension and asymptomatic disease of the urinary organs, and (3) cases of essential hypertension.

In the first group, in both males and females and in all age groups, may be found the obstructive uropathies such as hydronephrosis from ureteropelvic juncture obstruction and obstruction at the vesical neck or in the urethra.

In the second group are to be found those cases of the so-called Goldblatt kidney, unilateral renal disease, usually with atrophy of the kidney and changes incident to pyelonephritis. These changes may be found in many people, but hypertension does not necessarily follow. These cases are not extremely common, yet they are being found all the time, and astonishing relief of the hypertension is seen in some after nephrectomy.

Barker and Braasch studied a large series of cases of hypertension at the Mayo Clinic, in which careful urologic studies were made,

and found that approximately 1 per cent of the cases had renal lesions amenable to surgical treatment. Among other things they concluded that "clinical analysis of these cases from the standpoint of hypertension failed to reveal information which was of value in preoperative prediction of the effect of nephrectomy on the subsequent course of the hypertension. No specific urologic or pathologic observations were noted in the affected kidney which would indicate whether good or poor results would follow nephrectomy."

Essential hypertension is as yet a disease condition of unknown etiology. Goldblatt from his studies suggested that an alteration of kidney blood flow may increase the pressor substance production with a coincident hypertension. The rôle of renin and angiotonin, both pressor substances elaborated by the kidney in the production of hypertension, is debatable. In other words, the kidney may be a factor in the production of or may simply undergo changes incident to the hypertension.

The selection of cases of hypertension suitable for thoracolumbar sympathectomy is a most difficult problem. As several writers have pointed out, an unfavorable impression of the operation might be formed if one studies some of the earlier reports. Some of the poor results may have been in patients for whom the operation would not now be advised.

Some clinics have grouped their cases according to the classification of Wagener and Keith and offer operation to certain cases in some of the groups. They point out that a mechanical grading of patients with hypertension contains many pitfalls. A patient may have serious myocardial changes due to coronary disease and show only minimal eye changes or renal involvement, or the reverse may be true.

DeTakats and his group select their cases very carefully and for their own purposes classify their cases in three groups. The first group consists of the following: (1) the patient 40 years old or under; the younger the patient, the more likely the disease is to be progressive; (2) the patient whose family history commonly shows other cases of hypertension; (3) the patient whose eyegrounds show minimal changes; (4) the patient in whom the systolic pressure varies from 200 to 150 mm. of mercury and the diastolic from 120 to 100 or to 90 if the patient is under 20, the pressure coming down to normal with rest or during natural sleep or with sodium amytal; (5) the patient whose heart is normal or shows minimal changes; and (6) the patient who has normal urine and normal renal function tests. In this group they also include some of the early adolescent hypertensive patients who are completely asymp-

tomatic but who have a family history of hypertension and show evidence of exaggerated vasomotor activity. Also included in this group are those patients with transient hypertension as defined by Levy and his associates. Operation is indicated for cases in this group.

Group 2 consists of patients in whom the advisability of operation is debatable. The chief argument for operating on these patients is that some of them obtain objective and subjective relief of symptoms. Some show a definite lowering of blood pressure. The ages in this group vary from 20 to 55. The group includes: (1) the patient with pronounced retinal sclerosis with angiospasm or occasional hemorrhage; (2) the patient whose diastolic pressure cannot be brought below 110 by any method; (3) the patient with an enlarged heart; (4) the patient with angina; (5) the patient whose urine contains albumen and casts but no blood cells; (6) the patient whose renal function is impaired; urea clearance should not be under 50 per cent of normal; and (7) the patient in whom a vascular accident may have occurred with minor residuals.

In the third group operation is not indicated and includes: (1) the patient with a fixed diastolic pressure ranging from 170 to 120; (2) the patient with severe changes in the eyegrounds (recurrent hemorrhages or exudates in the retina or papilledema); (3) the patient with congestive or anginal failure; (4) the patient whose urine contains albumen and casts; (5) the patient whose urea clearance is less than 50 per cent of normal; (6) the patient whose kidneys cannot concentrate below 1.015 and (7) the patient in whom a cerebral accident may have occurred.

Poppen does not advise operation for cases of early hypertension or those of a mild, slowly progressive nature. These patients are treated medically and carefully watched. It is well known that many such patients have practically a normal life expectancy. If a case shows evidence of progression into an advanced form, operation is advised. The duration of the disease is apparently no factor in the good result that may be obtained.

The presence or absence of renal disease demonstrated by our various methods of study is an important factor in the selection of cases. Nesbit and Plumb followed patients with hypertension who had structural abnormalities of the kidney as shown by pyelography, both unilateral and bilateral. They had splanchnicectomy by the Peet technic, which resulted in symptomatic improvement in most of the cases and lowering of the blood pressure. In one case of advanced renal disease there was no improvement, and death from uremia occurred in 2 months. The authors concluded that gross

renal disease does not in itself prevent an effective response to splanchnicectomy but that operation should not be advocated when the prognosis for life is adversely affected by advanced kidney disease.

In our clinic the study of these cases consists of the general history, the family history, the age of the patient, the duration of symptoms, general physical and routine laboratory examinations, phenolsulfonphthalein output, a dilution and concentration test, blood chemistry studies, plasma protein (albumin/globulin ratio), excretory urograms with cystoscopy if advisable, hourly blood pressure readings following the administration of 9 grains of sodium amytal, a chest film, and electrocardiogram, and blood pressure readings several times daily at bed rest and ward activity.

At the present time there is no single test nor group of tests by which cases may be selected for operation or which will prognosticate the results that may be expected in a given case.

In a small series of cases we have done the Craig-Adson procedure. We are now doing the Smithwick operation.

I shall not analyze the cases in detail but simply relate some of our impressions. Several of the patients who had the Craig-Adson procedure obtained relief from annoying symptoms, such as headache, dizziness, and tinnitus, without a marked drop in blood pressure, although all of them had definite lowering of the pressure.

In one case a woman 39 years of age came because of three pulmonary hemorrhages. She has been clinically quite well for 6 years but during the past year has shown a gradual increase in blood pressure. In this and several other cases we will advise a second operation for the removal of the thoracic portion of the sympathetic chain.

A 42 year old man had suffered three cerebral accidents and presented mild mental residuals and evidence of moderately advanced renal disease. He survived 9 months. There were no further cerebral accidents, and the blood pressure was definitely lowered and remained so. Death occurred from uremia.

As previously pointed out, if good results are to be obtained in the cases selected for operation, a type of operation must be done which will reduce the blood pressure to near normal limits.

In our cases there have been no serious accidents or complications. Hemorrhage, pneumothorax, and pulmonary complications secondary to injury to the pleura are always to be expected.

SUMMARY

A number of cases of hypertension may be relieved of annoying symptoms by various types of operative procedures on the sympathetic nervous system. The cases must be carefully selected, and there is no single test or group of tests or examinations that makes the selection of cases easy.

Probably the most important single contraindication to operation is renal disease, more specifically the degree and extent of parenchymal changes which are not reversible in nature.

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HYDROCELE OF THE CANAL OF NUCK*

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HYDROCELE of the canal of Nuck is a rare disease and is infrequently referred to in surgical literature. Textbooks on surgery simply mention that such a lesion exists, and description of the disease, if present at all, is meager. Price[7] could find only 8 references in medical literature for the period of 1908 to 1926. It is estimated that there were not over 350 cases reported in the world literature up to 1948. From 1940 up to the present time only 2 references in the American medical literature could be found. Counseller and Black[3] reported 17 cases from the files of the Mayo Clinic and McCune[8] reported an unusual case with a large retroperitoneal extension. Because of this scarcity of description and of reported cases of the disease, it is considered that a review of the pathology present, diagnostic considerations regarding the disease, and the report of a recently observed and operated case should be interesting and informative.

As in all other rare conditions, several theories of origin have been advanced. Hydrocele of the canal of Nuck is the exact counterpart of the encysted hydrocele in the male. It is an accumulation of fluid in the persisting diverticulum of Nuck which corresponds to the vaginal process of the peritoneum in the male. It is described by Te Linde[11] as "a tense fluctuating tumor which cannot be forced out of the inguinal canal." Graves[5] stated that it was a retention cyst due to the upper closure of the processus vaginalis peritoni which runs along the round ligament into the labium majus. Weber[12] thought they could result from the persistence of the original hollow condition of the round ligament. Gebhard[4] suggested that they originated in embryonic rests in the round ligament. It is the consensus that they form exactly as does hydrocele in the male. They therefore usually accompany but do not originate in the round ligament.

Anatomically, Nuck's diverticulum is a pouch of peritoneum covering the round ligament of the uterus and extending into the inguinal canal of the young female. In all female fetuses this pouch is present and later becomes obliterated, usually leaving a dimple or pocket at the internal inguinal ring of the adult. Nuck's canal is the canal formed by Nuck's diverticulum. Wharton[13] restricts the

*From Frasier-Ellis Hospital, Dothan, Alabama.

use of the term canal of Nuck to those instances in which the diverticulum persists in the inguinal canal and states that the cyst or hydrocele results from the closing off of this persistent peritoneal pouch.

All authors writing on this subject refer to Regnoli's[9] classic description and classification of this disease. He classified it into five types: (1) a diffuse hydrocele in cellular tissue enveloping the round ligament with transformation of the cellular tissue into a serous membrane, (2) an accumulation of fluid in a prolongation of peritoneum into the inguinal canal, the communication with the abdominal cavity remaining, (3) differs from the second only in the fact that the pouch of peritoneum no longer communicates with the peritoneal cavity, (4) an encysted hydrocele in the connective tissue about the round ligament, (5) and an accumulation of fluid in the remains of an old hernial sac.

Hydroceles of the canal of Nuck first appear as soft, slightly tender, often reducible masses in the inguinal region. They vary in size from small to very large and tend to increase in size the longer they are present. In the case to be reported the mass was reducible, but after it had been present for approximately 9 months, it lost this characteristic and became more tender to palpation and also became painful. Because of the infrequency of the disease, it is frequently misdiagnosed simply because it is not considered. In Counseller and Black's[3] series, 7 of the 17 cases were associated with hernia. This is, of course, the most frequent condition with which they are confused. Coley[2] and others[1,6,10] stress the elastic feel of the presenting mass, its location at the subcutaneous inguinal ring, the fact that it can be transilluminated, and its being irreducible as being pertinent diagnostic points. They seem to have no predilection for side of origin and a number of cases involving both sides have been reported.

Pathologically, these cystic masses must be lined by flat to cuboidal epithelium in single layers. This is true because of the possible confusion with adenomas of the inguinal canal. They may be unilocular or multilocular in structure. They are usually round or oval but may be shaped to conform to their position in the canal. They are usually tense due to pressure created by the contained fluid.

Because of the rarity of this disease, it is thought that the reporting of the following case is justified:

Case Report

This 32 year old, colored, married, female cook entered the hospital May 11, 1948, complaining of a tender, moderately painful, nonreducible mass in the right inguinal region which had been present for approximately one year.

When it first appeared it was nontender and reducible. It retained these characteristics for approximately nine months. When it first appeared it was about the size of a small lemon but slowly and steadily grew in size to that as presented on admission. She had had no acute pain in the mass, and review of symptoms was negative. Her past history was negative except for a previous pelvic operation approximately four years before this hospital admission. No member of her immediate family had had any such disease as her presenting complaint.

Physical examination was essentially negative except as related to the abdomen and inguinal areas. There was present a well healed lower midline abdominal scar. There were no abdominal masses or tenderness. Pelvic examination was negative for pathology. The uterus had been removed previously and there were no adnexal masses. In the right inguinal region there was a soft, moderately tender tumor mass which measured approximately 10 by 7 by 6 cm. It did not fluctuate nor pulsate, and it gave the examiner

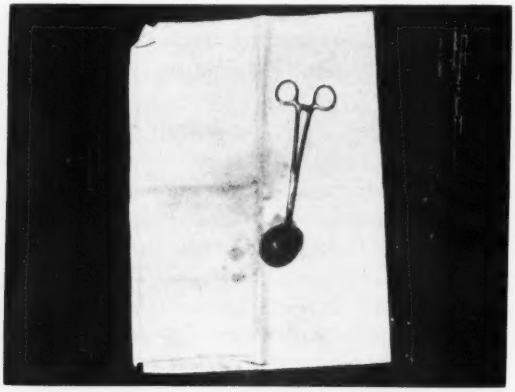

Fig. 1. A smooth multilocular cystic mass removed from the right inguinal canal and upper portion of the right labium majus.

the impression that it was a hernia containing omentum. It was irreducible and extended from the subcutaneous inguinal ring into the upper portion of the labium majus.

Laboratory examination showed a red cell count of 3,860,000, a white cell count of 8,000, a hemoglobin of 75 per cent, and an essentially normal differential. Her urine was clear straw colored, acid in reaction and contained no albumin nor sugar and the microscopic examination was negative. Her Kahn was negative and her stools contained no parasites.

On May 12 she was operated upon with a preoperative diagnosis of inguinal hernia, and a cystic mass in the right inguinal region was removed (fig. 1). It was described as extending from the upper portion of the right labium majus across the inguinal ligament into the inguinal canal. The round ligament could not be definitely made out and the cyst had a stalk-like communication with the peritoneal cavity which appeared to have a lumen approxi-

mately 1 mm. in diameter. Because of the peritoneal communication, it was decided that the abdominal wall should be treated as if a hernia were present (the preoperative diagnosis was hernia). All structures in the inguinal canal were removed and the canal obliterated by suturing the transversalis fascia, the so-called conjoined tendon, and the lateral border of the right rectus sheath to the shelving portion of the inguinal ligament. Interrupted nylon sutures were used throughout.

The following is the pathologic report of the excised cystic mass:

Gross Description: The specimen consists of ovoid thin-walled, largely transparent cyst 6 by 4.5 by 3.5 cm. On one side there is some fibromuscular tissue deposited at which appears to be a pedicle-like area. This deposit is 2.5 by 1 cm. On section the cyst is filled with a water-clear fluid. The lining is smooth except along one side where there are a number of grayish-white fibrous trabeculations. At one place near these trabeculae, there is a bulging group of secondary cysts, and near this is one small grayish-white, brittle projection suggesting a fibrous excrescence.

Microscopic Examination: The sections show the wall of the cyst as mentioned in the gross. The wall consists of layers of fibrous tissue and blood vessels and occasional columns of smooth muscle. The blood vessels are arterioles and venules. The venules are often quite dilated. The cyst is lined by a single layer of flattened or cuboidal epithelium which in a few areas is piled up—probably, however, in areas of tangential section. The lining cells contain a hyperchromic nucleus that is ovoid or rounded. At one place there are formed several locules of thin-walled secondary cysts that bulge into the lumen as a papillary structure.

Her postoperative course was entirely uneventful. She was out of bed on her first postoperative day, the sutures were removed on the seventh postoperative day, and she was permitted to go home on the tenth day.

Comment

Careful pathologic study of the excised specimen would indicate that the round ligament as such was not present for the entire contents of the inguinal canal was excised. The muscle fibers described can be assumed to be remnants of the round ligament. It would therefore appear that the usual conception of the character of these hydroceles was not borne out by the study of the case for it was contained in the round ligament and did not accompany the same. This case cannot be classified in any of the five categories of Regnoli's classification, and though there seems to be some doubt about there ever being a lumen in the developing round ligament, the study of the specimen in this case would indicate that the cystic mass developed within the round ligament, destroying all of its gross identity and leaving only a shred of evidence of its previous existence when studied microscopically. The early reducibility can be attributed to its peritoneal communication which, as far as function was concerned, became obliterated during the course of the disease.

Summary

A discussion of hydrocele of the canal of Nuck has been presented along with a case report. Doubt as to the correctness of the usual concept of the disease is expressed for this cystic mass developed within the round ligament, destroying its identity. It cannot be classified in the five categories of Regnoli's classification.

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AN HISTORICAL REVIEW OF THE DEVELOPMENT OF CESAREAN SECTION

THE history of a surgical procedure so eloquently described in the following quotation should be fascinating to all doctors and even engrossing to those who are called upon to accomplish it: "An operation so grand in its simplicity, so brilliant in its success, so mysterious in its disasters, is well calculated to impress the imagination of mankind. Its very name has an imposing sound, and carries the mind back to the imperial grandeur of Rome. Its origin has been placed amid the twilight ages of the gods."[1]

The exact origin of cesarean section on the living is impossible to establish from past literature on the subject. Pliny, the naturalist who lived from 23 to 79 A.D., states that Julius Caesar was born in this manner; however, no evidence has been presented to substantiate this fact. To the contrary, it is known that Caesar's mother, Aurelia, lived many years following his birth as is evidenced by the letters she wrote to him during his military campaigns. Further-

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more, at the time of Caesar's birth cesarean section was not practiced on the living. The best medical book of its time, De Re Medica," written by Celsus in 30 A.D., which was published after Caesar's time and in Pliny's childhood, makes no mention of the cesarean operation but does give complete details of removing a dead baby by means of crochet. In the Punic tongue "Caesar" signifies an elephant. It is stated that one of the earlier Caesars kept, or killed, an elephant and became known by this name. Julius Caesar, after becoming master of the Roman Mint, in a benign effort to satisfy his egotism, placed the figure of an elephant on the reverse side of public money, as it was unlawful for a private citizen to stamp his name on a coin of the State. Caesar's alleged birth by cesarean section is said to have originated with historians in order to surround this great military leader with mystery and elevate him above the common man. Pliny was noted for his lively imagination, and according to Young[2] he exercised it to the fullest in connecting Caesar's birth with cesarean section.

The term "cesarean" has two possible origins. According to Palmer Findley[3] the word is derived from the Latin, partus cesareus from caedre, which means to cut and signifies delivery by any cutting operation. For many generations children delivered of dead mothers by cutting operations were known as cesones. Newell[4] gives a second explanation of the origin of the cesarean operation. In 715 B.C. Numa Pompilius, second King of Rome, codified the Roman law, and in this Lex Regia specifically directed that all mothers who died late in pregnancy be delivered by cesarean section so that mother and child could be buried separately. The Lex Regia became the Lex Cesarea under the rule of the emperors, and the operation became known as the cesarean operation. From the time of Numa Pompilius to the 16th century it was common practice to perform cesarean section on dead mothers only. The Talmud refers to children delivered in this manner. They were called Jotze Dofan by the ancient Jews.

The first to use the term "section" in connection with the operation was Jacques Guillimeau in his book of midwifery published in 1598.[2] "Cesarean section" was again used in a book published by the Jesuit, Theophile Raynaud in 1637.[5]

The influence of religion played a great part in the development of this operation. It was encouraged by the Catholics especially in order to save the child after the death of the mother. Christianity in general advocated the performance of this procedure; however, the Mohammedan religion forbade this operation and directed that any child so born must be slain forthwith, as it was an offspring of

the devil. This particular teaching is not strictly adhered to at the present time. As late as 1830 a Catholic priest named Sarria,[6] who was head of a mission in California, wrote detailed instructions for the proper performance of post mortem cesarean section to all missionaries under his supervision. These instructions were complete and specific. He directed that the operation be done within two hours following death and recommended three tests to be made to determine the time of expiration. Instances are recorded in which it was common practice to place a gag in the mother's mouth after death so the baby would not suffocate before it could be extracted by operation.

Many startling and unusual cases of cesarean section being performed by patients upon themselves have been reported. The first recorded case was that of a negro slave woman, mother of four children, who performed the operation upon herself with a broken butcher knife in Kingston, Jamaica, West Indies, in 1769. A midwife sewed up her abdomen and later a surgeon opened the wound, removed the placenta and dirt from the abdominal cavity and resutured the wound. The mother lived and delivered a subsequent pregnancy in the normal manner.[7] On Jan. 29, 1822, according to Dr. Harris,[8] a 14 year old girl performed a cesarean section on herself with a razor in a snowbank to deliver a second twin. Both babies were lost, but the mother lived. The patient was a servant girl of Dr. E. D. Bassett of Nassau, New York. The most unusual case of self-performance of a cesarean section is one reported by Drs. Baliva and Serpieri in 1886.[2] A 23 year old unmarried peasant girl performed a cesarean on herself at 3:00 o'clock in the morning. Her motive for doing this was to silence the unpleasant whisperings of the neighbors. The baby was mutilated. At 5:00 a.m. the patient dressed and walked to town, a distance of more than one half mile. She had breakfast with her sister, after which she walked around town to prove to everyone she was not pregnant, then walked home where she collapsed. The doctors arrived at 4:00 p.m., thirteen hours after the operation, cleaned the intestines, replaced them into the abdomen and closed the wound. In forty days the patient was well.

In 1887 Harris[9] collected data on eleven cesarean sections performed by cattle-horn lacerations of the abdomen and uterus of women late in pregnancy. Seven of these mothers lived. The initial case occurred in Zaandam, Holland, in 1647. Jacob Egh's wife came to his rescue as he was being gored by an enraged bull. Her abdomen was ripped open and a baby delivered that lived nine months. Both mother and father died shortly after the accident. A painting commemorative of the incident hung in one of the

churches of Zaandam and caused it to be known as the "Bull Church." Dr. George E. Powell of LaCrosse, Wisconsin, reported to Dr. Harris of witnessing in his youth a cesarean section done by a bison bull on a Pawnee Indian woman in Nebraska. She was treated by the Indians in their traditional manner, and both mother and baby survived the accident. In writing the play, "Macbeth," Shakespeare used "The Chronicles of Englande, Scotlande and Irelande" by Raphael Holinshead in which Macduff was made to say, "I am even he that the wizards have told thee of who was never born of my mother but was ripped out of her womb." Up to this time, 1577, not a single authentic, successful cesarean section had been recorded, and even in 1887 more mothers lived if subjected to accidental cattle-horn cesarean section than if the operation had been performed by the ablest surgeon of the time. This led Dr. Harris to aver, "if Macduff told the truth he is much more likely to have been delivered by a horn or a sword than by the knife of a surgeon."

Jacob Nufer, a swinegelder of Sigerhausen, Switzerland, in the year 1500 is presumed to have performed a cesarean section on his wife after thirteen midwives had failed to deliver her. She lived and bore several children after the operation. This case was reported by Caspard Bauhin almost a hundred years after its occurrence and, for the most part, by heresay. Most historians believe this case represented an operation for extrauterine pregnancy and was, therefore, not a true cesarean operation.

The first authentic recorded case of a cesarean section is the one performed by Jeremias Trautmann on April 21, 1610, in Wittenberg, Germany. Cristoph Gusth assisted in the operation, and witnesses present were Professor Daniel Sennert, Dr. Ernst Hettenback, Dr. Tobias Yundler, the archdeacon of the parish church, M. Heinrich Silbermann, two midwives and several other honorable women. The patient died on the twenty-fifth postoperative day after becoming ambulatory. Autopsy revealed no hidden suppurative process. It is interesting to note that this first cesarean section was similar to the operation described by Portes of Paris in 1923 in that the uterus was allowed to involute outside the abdominal cavity. From 1610 to 1876 cesarean section was performed with only slight success around the world. Up to the year 1876 not a single mother was saved by this operation in the great maternity hospitals of Paris and Vienna. The first successful cesarean section in Great Britain was performed in January of 1738 by an Irish midwife named Mary Donnelly. The patient was Alice O'Neale of Charlemont, Ireland. Dr. James Barlow performed the first cesarean section in England on Nov. 22, 1793. The mortality of this opera-

tion was appalling during this period. Baudelocque (Jean Louis)[10] wrote in his "Memoirs on the Cesarean Operation," published in 1801, "we can scarcely promise ourselves to save one woman in ten." Osiander,[11] in 1805, stated, "it cannot be denied that of the women who undergo cesarean section more than two thirds die, and barely a third are saved. Cesarean section belongs to those operations of which the outcome is entirely uncertain. Before thus undertaking this procedure one should allow the patient to draw up her will and grant her time to prepare herself for death." Some historians have avowed that Edward VI, son of Henry VIII and Jane Seymour, was born by cesarean section. It is stated when Henry VIII was asked by the attending obstetrician if a cesarean section or craniotomy should be performed he replied, "save the child by all means as wives are much easier to get than children." Jane Seymour died on the twelfth postpartum day of puerperal sepsis. So mortal was this operation in the 16th century that some have claimed that Henry VIII ordered the operation to rid himself of an undesirable wife.

Sacombe asserted that Catharine de Medici suggested on the eve of the Saint Bartholomew's Day massacre that the Huguenot women found pregnant at term should be delivered by cesarean section in order to extirpate the breed.

During the latter part of the 18th century the development of cesarean section was retarded by a new procedure, symphysiotomy. Although short-lived, many doctors dropped cesarean section in favor of this deforming operation. In 1777 M. Sigault performed the first symphysiotomy. For this daring achievement he was awarded a medal and a pension by the Government of France. The courageous patient was also awarded a pension.

Dr. Jesse Bennett[10] performed the first cesarean section in the United States on Jan. 14, 1794, in Rockingham County, Virginia. This operation was performed on his wife in her first pregnancy and was witnessed by Dr. Humphreys of Staunton, Virginia, Mrs. Bennett's sister, Mrs. Nicholas Hawkins, and two negro servants. Both ovaries were removed at the time of the operation, which caused one of the witnesses to remark, "he spayed her." Dr. Bennett's notes on his operation were brief, yet definite. Following 24 case reports published in Baudelocque's "Memoirs on the Cesarean Operation," Dr. Bennett made the following notation in the margin of page 71: "25th. 14 Jany 1794 J. B. on E. B. Up 9 Feby, Walked 15 Feby, Cured on 1 March" (fig. 1). Both mother and baby lived. Dr. Bennett's daughter lived to be 77 years old and became the wife of Dr. Enos Thomas. Dr. Bennett lived a successful and happy

(71)

21st and 22d. LAMBRON, Surgeon at Orleans, has performed the same operation twice upon one woman (1), who has since laboured very fortunately. She was operated upon the first time, on the 9th of August 1775, and the second time on the 30th of December 1779.

23d. DUMAY, Surgeon at Fontenai-le-Peuple, performed the same operation on account of a rupture of the uterus, although the fœtus had not penetrated into the belly, on the 4th of Germinal in the 4th Year, (23d March 1796) and on the 30th day the wound was not larger than a shilling (2).

24th. Finally Mr. BACQUA has performed the cesarean operation more recently, namely on the 25th of Floreal in the 5th year, (14th May 1797) and has met with all the success, that could bedesired from it (3).

14 Jan'y 1794 ... on ... up 9 Feb'y Walked 15 Feb'y Cured on 1 March

(1) The womb of this woman was lacerated in two successive labours and the infant, each time, passed completely into the cavity of the abdomen.

(2) This observation, highly interesting to the progress of the art, will be published at full length in the Recueil, when the further account of it, which has been requested, shall be received.

(3) See *Recueil Periodique* pag. 436, tom. IV.

Fig. 1. An Authentic record of the first cesarean section performed in the United States, as recorded by Dr. Bennett on page 71 of his copy of "Memoirs on the Cesarean Operation," by Baudelocque (Miller, J. L.: Ann. M. Hist. *10*:23-25, 1938).

life after performing the surgical feat of the century, and in the War of 1812 served as Surgeon with the Virginia Regiment. Aaron Burr tried unsuccessfully to persuade him to join his expedition. Later Dr. Bennett was summoned to Richmond to testify in the trial of Aaron Burr and at this time had his portrait painted (fig. 2). It is in the possession of his great granddaughter, Mrs. Mary Shaw Cargill, of Westfield, West Virginia, at the present time. His autographed copy of "Memoirs on the Cesarean Operation" by Baudelocque, containing his brief notes of the operation, is now a part of the Miller Library at the Richmond Academy of Medicine, Richmond, Virginia.

The honor of performing the second cesarean section in the United States goes to Dr. Francois Marie Prevost of Donaldsonville, Louisiana. The first operation performed by Dr. Prevost is dated by Matas[12] as 1822. He did a second cesarean section on the same patient in 1824 and a third section on another patient in 1825.

Fig. 2. Dr. Jessie Bennett, the first surgeon to perform a cesarean section in the United States, Jan. 14, 1794 (Miller, J. L.: Ann. M. Hist. *10*:23-25, 1938).

He again performed the operation in 1831. Of the eight lives jeopardized incident to these four operations, Dr. Prevost saved seven. Only one mother was lost. The others survived the operation, and all four children lived. The operation performed in 1831 was on Caroline Bellau, a slave girl owned by Madame Cadet Maurous. The baby, a girl, was named Cisarine and was set free according to prior agreement between Dr. Prevost and Madame Maurous.

The third doctor in the United States to do this procedure was Dr. John L. Richmond of Newton, Ohio. The operation was performed on April 22, 1827, and the mother only was saved. During the eight year period, 1827 to 1835, six additional cesarean sections were performed in the United States. The date, place and surgeon are as follows:

1828	Occoquan, Virginia	A charlatan[7]
1831	New Orleans, La.	Dr. Charles A. Luzenberg[12]
1832	Near Northumberland, Pa.	Drs. Dougal and Van Valzah[7]
1832	Donaldsonville, La.	Dr. Thomas Cottman[12]
1833	Columbiana Co., Ohio	Dr. Robert Estep[7]
1834	Columbiana Co., Ohio	Dr. Robert Estep[7]

The scene for the next remarkable performance of the cesarean operation in the United States shifts to Philadelphia. The patient, Mrs. Reybold, had successive embryotomies performed in 1831 and 1833. She came to full term pregnancy for the third time in 1835. Her obstetrician refused to do a third embryotomy, and because of this Dr. William Gibson of Baltimore performed a suc-

cessful cesarean section. A section was repeated by the same surgeon on Mrs. Reybold two years later. She survived both operations, together with the two children. Mrs. Reybold lived to the age of 76, and six grandchildren resulted from these two sections.

During the 19th century the efforts of the medical profession were directed toward improvement in technic. In performing the operation, suture material came into use, cesarean hysterectomy for the infected case was advocated, and the low segment operation was developed.

Lebas of Mouilleron, France, was the first to suture the uterus following cesarean section in 1769. Dr. Lebas was severely criticized by his colleagues for placing foreign bodies in the uterus to interfere with its normal contraction. In this country, Dr. Frank E. Polin[13] of Springfield, Kentucky, in December, 1852, was the first to use sutures in the uterus. The patient was Mrs. Mary Brown, and the indication for section was hydrocephalus. Dr. Polin used silver wire sutures. Mrs. Brown survived and delivered two normal babies following this operation. Dr. Marion Sims had published in January of 1852 his experience with the use of silver wire as suture material. Others in the United States to advocate and use suture material in the uterus were Dr. Warren Brickell of New Orleans in 1867 and Dr. T. Beers Townsend of New Haven, Connecticut, in the same year.

In 1871 C. F. Rodenstein of Westchester, New York, as a young assistant, was left to close a case following cesarean section. Because of the profuse uterine hemorrhage he closed the uterus with silk sutures to stop the bleeding. The surgeon in the case returned and strongly criticized Dr. Rodenstein's action. On the third day the patient was reopened by the surgeon and the sutures removed.

Professor Porro of Pavia, Italy, conceived and executed cesarean hysterectomy. The mortality following cesarean section was so great up to this time that few patients were operated upon electively. All patients were infected due to long hours of labor, and most died as a result of infected material spilling from the uterus into the peritoneal cavity. Porro's operation prevented this by removal of the uterus before removing the baby. This operation was first performed in 1869 in Boston by Dr. Horatio Storer for obstructed labor due to uterine fibroids. Dr. Storer's action was an emergency measure to control hemorrhage. Others who had recommended extirpation of the uterus to prevent infection were Dr. Joseph Cavallini in 1768 and Dr. James Blundell in 1828. Dr. Cavallini did animal experiments to prove the merits of this procedure but never attempted the operation. Dr. Blundell mentioned

cesarean hysterectomy in his hospital lectures; however, there is no record of his executing his teachings. On May 21, 1876, Porro deliberately performed a cesarean hysterectomy following seven hours of labor on a 24 year old primipara, whose name, by a strange coincidence, was that of Cavallini. The outcome of the operation was successful for baby and mother. The principle of the Porro operation in infected patients is practiced by some of the leading obstetrical authorities of the present day, although the technic has been improved in that the tubes and ovaries are left intact, and the cervix is closed and dropped into the pelvis.

Although Max Sanger of Leipzig is credited with instituting the use of suture material to close the uterine incision and originating the classical section as we know it today, it was Ferdinand Adolph Kehrer[2] who, in 1881, closed the muscle of the uterus in layers and then closed the uterine peritoneum separately. Kehrer also recommended and used the lower segment incision. Dr. Kehrer's son who became a famous professor of obstetrics said, "the birthplace of abdominal cesarean section is a lowly cottage in the village of Heidelberg and its birthday is the 25th of September, 1881." Max Sanger, in 1882, advocated and popularized layer closure of the uterine musculature, emphasizing the importance of covering the uterine incision with the peritoneal layer by means of Lembert sutures. This closure was recommended to control hemorrhage and prevent the seepage of lochia into the peritoneal cavity. Since 1882 classical and Sanger cesarean section have been synonymous terms.

One is impressed with the fact that Sanger and Porro, with their revolutionary ideas, were responsible for improvement in the mortality of cesarean section. The work of five men, however, became generally known about the time Sanger and Porro published their work, and it is to these great men that much credit is due for the part their discoveries played in the reduction of deaths following cesarean section.

Dr. James Young Simpson of Scotland was first to use anesthesia in obstetrics. Dr. Oliver Wendell Holmes of Boston was one of the discoverers of the contagiousness of puerperal fever. Dr. Ignaz Philipp Semmelweis, a Hungarian, recognized the importance of antisepsis in obstetrics and zealously taught the contagiousness of puerperal fever. Dr. Louis Pasteur, the discoverer of microorganisms, is known as the father of bacteriology. By making practical application of Pasteur's discoveries, Lord Lister elevated surgery to the aseptic era. To these outstanding men, for their discoveries and teachings in making the science of surgery safer, is due a debt of gratitude that can never be adequately expressed by humanity. The fruits of their work reflect credit to Porro and Sanger. To

this list of illustrious scientists, future historians will add the name of the first to give a blood transfusion and that of the discoverer of penicillin.

Even before Sanger's and Porro's method of cesarean section became known to the world, the medical profession was continually searching for a safer way to perform this remarkable operation.

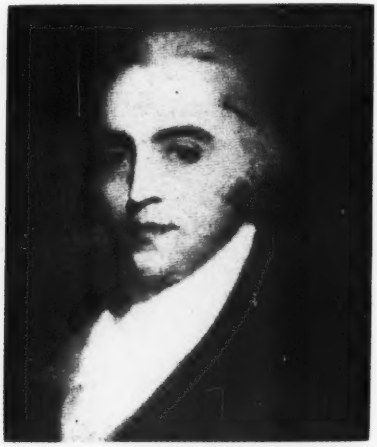

Fig. 3. Philip Syng Physick, the first to describe, in 1824, an extraperitoneal approach to the lower uterine segment. (Photograph, courtesy of the publishers of "Garrison's History of Medicine.")

The development of the lower uterine segment operation as it is done today was attempted by Osiander of Goettingen, Germany, in 1805. He recognized the disastrous results of the incision being made through the body of the uterus and in searching for a safer approach was first actually to perform a low segment operation. Joerg of Leipzig proposed a similar type procedure the following year. Ritgen of Giessen, Germany, in 1821 was first to attempt the performance of an extraperitoneal cesarean section (gastroelytrotomy). He ran into hemorrhage and abandoned the procedure in favor of the classical cesarean section. Two years later Louis A. Baudelocque, nephew of Dr. Jean Louis Baudelocque, attempted Ritgen's operation but also met with failure due to hemorrhage. It was not until 1881 that Kehrer performed the first transperitoneal lower uterine segment operation. The principle of the original Kehrer technic has been used with increasing frequency since 1920. A. C. Beck and James B. DeLee in this country, and J. Munro Kerr and C. McIntosh Marshall of England have been responsible for teaching the medical profession the technic of this procedure and its advantages over the classical type.

Following the failures of Ritgen and Baudelocque in the performance of a true extraperitoneal cesarean section, Philip Syng Physick of Philadelphia, Professor of Surgery, University of Pennsylvania, and father of American surgery, in 1824 laid the anatomic foundation for the correct performance of a true extraperitoneal cesarean section. He described in detail the anatomy involved in a letter by Dr. W. E. Horner that was published in Dewees' textbook of midwifery.[14] Although Dr. Physick never performed the operation, he possessed the correct anatomic concept. It was his description that influenced Frank in 1906 and Sellheim in 1907 to renew interest in this procedure. Latzko, in 1908, developed the paravesical approach to the lower uterine segment, after which the Frank and Sellheim procedures, which were supravesical approaches to the lower uterine segment, were abandoned in favor of the Latzko technic.

In 1940 Dr. Edward G. Waters[16] of the Margaret Hague Maternity Hospital demonstrated the anatomy described by Physick one hundred sixteen years previously. Waters repeatedly proved that the lower uterine segment could be reached without entering the peritoneal cavity provided the peritoneum and perivesical fascia were stripped from the bladder in one layer. During the past eight years Waters' operation has been performed with increasing frequency throughout the United States in potentially and actually infected obstructed labor cases.

During the past three years, from Jan. 1, 1945, to Jan. 1, 1948, the total number of cesarean sections performed in every hospital in Alabama was 3,205. The mortality for these 3,205 operations was .96 per cent.[17]

It was almost one hundred and fifty years ago that Baudelocque wrote ". . . we can scarcely promise ourselves to save one woman in ten." How different today!

BUFORD WORD, M.D., F.A.C.S.

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BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

OPERATIVE TECHNIQUES IN GENERAL SURGERY, VOL. 1, edited by WARREN H. COLE, M.D., F.A.C.S. Introduction by FRANK H. LAHEY, M.D., F.A.C.S. New York: Appleton-Century Crafts, Inc., 1949.

The editor has assembled here some of the best authorities in American surgery today for a volume of excellent works. The individual authors have been well chosen to write authoritatively about their respective subjects.

The work is well organized and written in a manner that makes reading easy and pleasant. Each subject is attacked in a logical manner, usually first reviewing the disease, the anatomy, the surgical and pathologic physiology, then the treatment. The surgical technic is clearly explained, and in many instances adequately illustrated. The preoperative management is included in some of the chapters, while little is said about postoperative management.

The methods and principles discussed coincide with the most modern accepted ideas. Many of the over 2000 illustrations are excellent but a few are made with a smudge technic which failed to reproduce as well as the etched drawings. The subject matter of the illustrations is very good.

This volume should prove an excellent addition to the library of all surgeons.

A. H. L.

DR. MICHOLSON J. EASTMAN, OF JOHNS HOPKINS, TO DELIVER FIRST E. C. DAVIS MEMORIAL LECTURE

The committee of the E. C. Davis Memorial Obstetrical Lectureship announces that Dr. M. J. Eastman, Obstetrician-in-Chief of the Johns Hopkins Hospital will deliver the first E. C. Davis Memorial Lecture, Friday, October 7, at 8:15 P.M., at the Academy of Medicine, in Atlanta.

The title of Dr. Eastman's Lecture, "The Physiology and Pathology of Uterine Contractions," is one in which he and his associates have been doing a great deal of research work the last few years, and should prove of interest to obstetricians and to all physicians who do obstetrics. The lecture will be illustrated.

UROLOGY AWARD

The American Urological Association offers an annual award of $1,000 (first prize of $500, second prize $300 and third prize $200) for essays on the result of some clinical or laboratory research in urology. Competition shall be limited to urologists who have been in such specific practice for not more than five years and to residents in urology in recognized hospitals.

The first prize essay will appear on the program of the forthcoming meeting of the American Urological Association, to be held at the Hotel Statler, Washington, D. C., May 29 to June 1, 1950.

For full particulars write the Secretary, Dr. Charles H. de T. Shivers, Boardwalk National Arcade Building, Atlantic City, N. J. Essays must be in his hands before Feb. 20, 1950.